KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY RECORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, JULY 28, 1882.

CONTENTS OF No. 39.

	PAGE
Was Rameses II. the Pharaoh of the Oppression? Part V. By Miss A. B. Edwards	141
Stimulants and Study. By the Editor	142
Future Sources of our Food Supply. Part II. By Percy Russell	143
Nights with a Three-inch Telescope. By F.R.A.S. (*Illustrated*)	144
A Ghost Story	145
A Theory of Foresights	146
Home Cures for Poisons	146
Lower Life Forms	147
Professor Owen on Vivisection	147
Weather Charts for the Week	148
Science and Art Gossip	148
Correspondence:—An Effective Accumulator—Progenitor of Vertebrata—Double Star Castor—Vitreous Glaze for Stone, &c.	149
Answers to Correspondents	152
Our Mathematical Column	154
Our Chess Column	155
Our Whist Column	156

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By AMELIA B. EDWARDS.

V.—THE HYKSHOS KALENDAR AND THE EXODUS, ACCORDING TO THE SYNCHRONOUS THEORY.

IT has been suggested that Sut-aa-peh-peh Nubti instituted his Kalendar when he ascended the throne. This is pure assumption. We know nothing of Nubti but his name; and we know nothing of his Kalendar* beyond the fact that it had been founded 400 years before the tablet of Sān was erected by command of Rameses II.

But what we are fairly at liberty to conjecture is that Nubti, at some undetermined point in the course of his reign, sought to correct the fluctuations of the vague year by the substitution of a fixed year,† and that his improved Kalendar, though apparently set aside by the Pharaohs of the Restoration (*i.e.*, XVIIIth and XIXth dynasties), was still in vulgar use 400 years later among the semi-Semitic populations of the Delta. Let us say, then, that Nubti instituted his Kalendar in the year B.C. 1800, just 338 years before the commencement of the XIXth dynasty, and 97 years before the restoration of the native monarchy in the person of Ahmes, first Pharaoh of the XVIIIth Dynasty, B.C. 1703. At this time (B.C. 1800) the Hykshos dominion was about midway of its third dynastic line, and at the height of its prosperity and splendour. The tributary princes of Thebes had as yet shown no disposition to revolt; and the war of liberation—which did not break out till the reign of Apapi, and which, as I have already observed, cannot have been an enormously protracted war—was still far distant. It was therefore about this time, when there was peace throughout the land and peace along the frontiers, that Joseph must have appeared upon the scene. We may assume that he was born B.C. 1836, and that, having been sold as a slave to one Potiphar (Egypⁿ. *Peti-pa-Ra*: *i.e.*, Devoted-to-Ra), a native Egyptian officer in the service of the Hykshos sovereign, he was cast into prison upon an unjust charge B.C. 1808, being then twenty-eight years of age. Two years later (B.C. 1806) he would have been brought forth to interpret the king's dream; being, as it is expressly stated, "thirty years old when he stood before Pharaoh King of Egypt" (Genesis, Chap. xli., v. 46). This would be just six years before the institution of the Hykshos Kalendar, in B.C. 1800; and as the Bible narrative, which is here unusually precise, shows all this chain of important events to have happened under a single Pharaoh, we must conclude that the king who dreamed of the seven high Niles and the seven low Niles, and who raised Joseph to power because of the interpretation of his dream, could have been none other than Sut-aa-peh-peh Nubti.

From this point (B.C. 1806) we have now to reckon the seven years of plenty, in the sixth of which the King founded his Kalendar. The year B.C. 1800 marks, therefore, the new era of Nubti; and the year B.C. 1799 marks the last year of the good Niles. Next begin the seven years of low Nile* and scant harvest, after two of which, Joseph's brethren come from Canaan to buy corn. This brings us to B.C. 1797. Allowing a year for their double journey, and for the journey of Isaac and his household, we may next assign B.C. 1796 for the entry of the Hebrews into Egypt. From this time to the death of Joseph (if we credit him with the full traditional 110 years of life) we have to count seventy years, so bringing us to B.C. 1726; that is to say, to twenty-three years before the accession of Ahmes, B.C. 1703. During these seventy years, Nubti will have died and been succeeded by Apapi, who erects a magnificent temple to Set,† and adorns it with an avenue of human-headed sphinxes, carved in the likeness of his own features. By this act, and by the despotic fanaticism with which he sought, apparently, to promulgate the cult of Set among the tributary rulers of Middle Egypt, Apapi roused the slumbering hatred of the conquered race. A revolt broke out, headed by Sekenen-Ra Ta-aa, prince of Thebes. The revolt speedily became a national war, which, as recorded in the before-mentioned tomb at El Kab,‡ ended only with the final expulsion of the Hykshos. If, therefore (accepting Mariette's dates for the commencement of the XVIIIth Dynasty, B.C. 1703, and for the expulsion of the Hykshos in the sixth year of Ahmes, B.C. 1697), we allow thirty years for the duration of the struggle, we must take B.C. 1727 for the date at which it began. This would be one year before the death of Joseph.

* If the mounds of Sān were thoroughly excavated, nothing is more likely than that a tablet, or many tablets, might be found, engraved with this kalendar in full, like the sculptured kalendars of the temples of Denderah, Edfoo, and Medinet Haboo.

† The Egyptian year consisted of twelve months of thirty days each, to which were added five extra days (*epact*) to bring up the number to 365. Even so, the year fell short of the right time by a quarter of a day, which caused a loss of one whole day in every four years, and thus, in course of time, changed the relative positions of the seasons. Many attempts were made at various periods to substitute a fixed year; but none were successful until the Alexandrian year (which began on August 20) was established during the Roman period.

* The dreams of Pharaoh are essentially local. The seven fat kine, signifying prosperity, may be interpreted to mean the seven mystic cows, companions of Osiris-Apis, which we see represented in the vignettes to various copies of the *Ritual*; and the seven lean kine, ominous of famine, may well be the seven cow-headed goddesses known as "the Seven Hathors"—minor divinities resembling capricious fairies, whose function it was to distribute good and ill luck. They "came up out of the river," which distinctly points to the annual inundation of the Nile; while the seven ears of good corn followed by the seven ears of blasted corn, as distinctly refer to the good and bad crops consequent on seven good Niles followed by seven bad Niles.

† Set, or Sutekh, the national God of the Hykshos and the Hittites. Three of these sphinxes were found *in situ* by Mariette.

‡ See KNOWLEDGE, No. 35, p. 65.

The rest of our calculation is soon made. The XVIIIth Dynasty, beginning with Ahmes, B.C. 1703, and ending with Horemheb, B.C. 1462, lasted exactly 241 years. The XIXth Dynasty began with Rameses I., and Rameses I. (who reigned from B.C. 1462 to B.C. 1456), was succeeded by Seti I. Seti I. reigned for fifty-one years—*i.e.*, from B.C. 1456 to 1405. He, however, took his son, Rameses II., into partnership; and this partnership, in the opinion of Brugsch, extended over the last thirty years of his reign. It would, therefore, have begun in B.C. 1435. And now, observe (for here is the turning-point of Brugsch's synchronous theory), *Rameses II. begins to date his reign from this period of partnership.* From B.C. 1435 we must accordingly count the sixty-seven years of his reign, which would close with his death in the year B.C. 1368. In the meanwhile Seti I. has died B.C. 1405, five years after which event, in the year B.C. 1400, Rameses II. celebrates the fourth centenary of Set-aa-peh-peh Nubti, by erecting the famous "Tablet of 400 years" at Zoan (Tanis). Finally, Rameses II. is succeeded by his thirteenth son, Menephthah, B.C. 1368. Moses, who had fled to Midian forty years before, now returns to Egypt for the purpose of delivering his people. The story of his contention with Pharaoh, as told in the Book of Exodus, covers apparently but a short time. The plagues of Egypt follow swiftly one upon another, and we shall probably not be far wrong if we place the flight of the Hebrews in the second year of Menephthah's sole reign—that is, in B.C. 1366. It now only remains to be seen how this date would correspond with the term of the Hebrew sojourn, as recorded in the Mosaic narrative. Turning to the Book of Exodus, we find that "the sojourning of the children of Israel who dwelt in Egypt was four hundred and thirty years. And it came to pass at the end of the four hundred and thirty years, even the self-same day it came to pass, that all the hosts of the Lord went out from the land of Egypt." (Exodus, chap. xii., v. 40-41.) No historical statement could possibly be more precise than this. Not only is the number of years twice recorded, but a singular coincidence is noted by way of corroboration. Although the same fact is elsewhere roughly stated in round numbers at 400 years, there cannot, I think, be any doubt that the careful and precise computation of the twelfth chapter of Exodus is that upon which we are bound to rely. All that we have therefore to do is to count back 430 years from the second year of the reign of Menephthah; and 430 years of retrograde calculation, beginning with the year B.C. 1366, will take us to B.C. 1796, which is the exact year already assigned to the arrival of Isaac and his household, in the third year of the famine.

STIMULANTS AND STUDY.

By the Editor.

THE Abbé Moigno gives the following interesting account of his experience, not only as to the effects of tobacco, whereof he had first only spoken, but of the effects of stimulants—or, rather, of the absence of stimulants—generally:—

"I have learned," he says, "twelve foreign languages, all by the method which I have [published in my 'Latin for All;' that is to say, I draw up the catalogue of the 1,500 or 1,800 root words, or simple primitive words, and I fix their meaning in my memory by mnemotechnic formulas. I had thus taken into my mind nearly 41,500 foreign words, whose connection generally, or oftenest, has no connection with the word itself, and from ten to twelve thousand facts, with their precise date.

"All this existed simultaneously in my memory, always at my disposal when I wanted the meaning of a word or the date of an event. If anyone asked me, for example, who was the twenty-fifth king of England, I perceived in my mind that it was Edward, called Plantagenet, who ascended the throne in 1154. I was, as respects philology and chronology, one of the most extraordinary characters of my time, and François Arago used laughingly to threaten to have me burnt as a wizard.

"But I had lately fallen into the practice of snuff-taking, and an abode of several weeks in Munich, where I passed my evenings in a smoking-room with the learned Bavarese, who would each smoke four or five cigars, and drink two or three cans of beer (the most illustrious of these *savants*, Steinheil, used to boast that he smoked six thousand cigars a year—*six tausend cigarren im yahr*), I attained to smoking three or four cigars a day. When I edited my treatise on the Calculus of Variations—the most difficult of my mathematical treatises—I would at times, without thought of mischief, use up in a day the whole contents of my snuff-box, which contains 25 grammes (nearly an ounce) of snuff. Now, I was painfully surprised one day to have to recognise that I was constantly obliged to turn to my dictionaries for the meaning of foreign words, which before happened to me seldom, or never, and that the dates of numerous facts which I had made my own had fled from my memory.

"In despair at this melancholy failure of my memory, I took forthwith an heroic resolution, which nothing since has been able to shake. On Aug. 31, 1863, I had smoked three cigars and used 25 centimes (about 2½d.) worth of snuff; the day following, Sept. 1, 1863 [usually, Ed.], and to the day of writing this, June 25, 1882, I have not taken a single pinch of snuff or smoked a single cigarette.

"It was for me a complete resurrection, not only of the memory, but of the general health and well-being. It was only necessary for me to do what I did eighteen years later, to diminish nearly one-half the quantity of food which I took each day, to eat less meat and more vegetable food, to obtain such incomparable health as one can scarcely imagine—indefinite capacity for work, unconscious digestion, perfect assimilation of food, no hæmorrhoids, no constipation, no wrinkles, pimples, &c., &c., and I may be permitted to affirm it with perfect confidence—those who follow in my footsteps will be rewarded as I have been.

"Add to this the habitude, irrevocably established, of never saying *I will do*, or *I am doing*, but *I have done*, and you have the secret of the enormous quantity of work I have been able to achieve, and which I achieve each day, despite my eighty years. No one will deny me, hereafter, the honour of having been one of the greatest workers of my age.

"I ought, finally, to add that I find it well for me to take at breakfast a small half-cup of coffee without milk, to which, when only two or three teaspoonsful remain at the bottom of the cup, I add a small spoonful of brandy, or other alcoholic liquor. That is my whole allowance of stimulants. How happy would those be who should adopt my *régime*. They would be able, without harm, to sit at their desk immediately after breakfast, and to stay there till dinner-time. No sooner would they be in bed, at about nine o'clock, but they would be softly asleep a few minutes later, and could rise at five in the morning, full of strength, after a nourishing sleep of eight hours.

"F. Moigno."

I would venture to add an expression of my own firm conviction that a life of study is aided by the almost entire avoidance of stimulants, alcoholic as well as nicotian.

I do not say that the moderate use of such stimulants does harm, only that so far as I can judge from my own experience it affords no help. I recognise a slight risk in what Abbé Moigno correctly states — the apparent power of indefinite work which comes with the almost entire avoidance of stimulants; but the risk is very slight, for the man must have very little sense who abuses that power to a dangerous degree. Certainly, if the loss of the power be evidence of mischief, I would say (still speaking of my own experience, which may be peculiar to my own temperament) that the use of stimulants, even in a very moderate degree, is mischievous. For instance I repeatedly have put this point to the test:—I work say from breakfast till one o'clock, when, if I feel at all hungry, I join my family at lunch; if now at lunch I eat very lightly and take a glass of ale or whisky-and-water I feel disposed, about a quarter of an hour later, to leave my work, which has, for the time, become irksome to me; and perhaps a couple of hours will pass before I care for steady work again: on the other hand, if I eat as lightly, or perhaps take a heartier lunch, but drink water only, I sit down as disposed for work after as before the meal. In point of fact, a very weak glass of whisky-and-water has as bad an influence on the disposition for work as a meal unwisely heavy would have. It is the same in the evening. If I take a light supper, with water only, I can work (and this, perhaps, is bad) comfortably till twelve or one; but a glass of weak whisky-and-water disposes me to rest or sleep, or to no heavier mental effort than is involved in reading a book of fiction or travel.

These remarks apply only to quiet home life, with my relatives or intimate friends at the table. At larger gatherings it seems (as Herbert Spencer has noted) that not only a heartier meal, but stimulants in a larger quantity, can be taken without impairment of mental vivacity, and even with advantage, up to a point falling far short, however, of what in former times would have been regarded as the safe limit of moderation. Under those circumstances, "wine maketh glad the heart of man," and many find the stimulus it gives pleasant,—perhaps dangerously so, unless the lesson is soon learned that the point is very soon reached beyond which mental vivacity is not increased but impaired.

I must confess it seems to me that if we are to admit the necessity or prudence of adopting total abstinence principles, because of the miseries which have been caused by undue indulgence—if A, B, and C, who have no desire to make beasts of themselves, are to refrain from the social glass because X, Y, and Z cannot content themselves till they have taken half-a-dozen social glasses too many—society has an additional reason to be angry with the drunkards, and with those scarcely less pernicious members of the social body who either cannot keep sober without blue ribbons or pledges, or, having no wish to drink, want everyone to know it. I admit, of course, if it really is the case that the healthy-minded must refrain from the innocent use of such stimulants as suit them, in the interests of the diseased, it may be very proper and desirable to do so: but only in the same way that it might be very desirable to avoid in a lunatic asylum the rational discussion of subjects about which the lunatics were astray. For steady literary or scientific work, however, and throughout the hours of work (or near them) it is certain that for most men something very close to total abstinence from stimulants is the best policy.

FUTURE SOURCES OF OUR FOOD SUPPLY.

By PERCY RUSSELL.

II.—AUSTRALASIA.

VICTORIA—the island of Tasmania alone excepted—is the most contracted in area of all the principal members of the Australasian group, yet, as I shall presently show, it can of itself furnish a very important quota to our national food supply. The estimated area—something less than that of Great Britain—is 56,446,720 acres, and of these there were available for selection on January 1, 1881, nearly 10,000,000 of acres, while other lands were constantly becoming available as settlement developed *pari passu* with the advance of the railway system of the colony. The area under wheat was computed at 707,188 acres, and the average yield was 13·29 bushels to the acre. Maize, oats, and barley were, and are, successfully grown, while all the ordinary English farm produce was raised in great quantity and perfection, together with vines, which are capable of almost indefinite expansion, assuming that Australian wines should once become fairly popularised in these realms of ours at home. The live stock return comprised 216,710 horses, 278,360 milch cows, horned cattle generally 850,998, and 8,651,775 sheep, to say nothing of pigs and poultry. Although the population was in 1881 no less than 845,997, it is clear that the agricultural wealth of the community was rich indeed beyond all normal old world standards, and then it must be remembered that Victoria is the most thickly populated member of the whole group, consequent on the large extent of Melbourne, which contained in 1881 no fewer than 280,836 souls—being, curiously enough, considerably in excess of the total population of South Australia, and more than half the entire population of New Zealand.

The agricultural and stock-raising capabilities of Victoria are very great. Indeed, almost all fruits and vegetables grown in the British isles, are produced with facility, while such is the marvellous fertility of some of the rich lands, that as many as 60 bushels of wheat have been obtained from the acre! The vineyards are advancing apace, in spite of the prejudice wherewith the Victorian vintages are still regarded in this country. The average yield is some 250 gallons per acre, and if fiscal matters could be only equitably adjusted, and these wines properly introduced amongst us, we might have a practically inexhaustible supply of sound, wholesome, genuine wine, giving us as a nation something infinitely better than the *vin ordinaire* of the continent at an approximately nominal price. This, indeed, is a matter which merits much more careful consideration than our government has get given to the subject, and the friends of Temperance know well that intoxication results chiefly, if not wholly, from beer and spirits. To make a nation generally a wine-drinking community is to take a long stride towards virtual national temperance.

Passing now to South Australia, we have to consider a region which in extent and productive potentiality, altogether transcends our insular ideas of what constitutes a considerable cereal producing region, Norfolk and Suffolk, for example, being big factors in the domestic calculations of our English farmers. The total area of the colony is estimated at about 903,690 square miles, or 578,361,000 acres. Of this vast area there had been alienated up to 1880 some 8,940,327 acres, while some 29,000,000 acres remained ready for settlement. There were in 1881, about 1,730,000 acres under wheat, yielding 8,600,000 bushels, while 4,337 acres of vines produced half-a-million gallons of wine. The live stock included 148,219

horses, 283,315 horned cattle, and 6,500,000 of sheep, but the population at the period in question was only 279,865 all told, whence it will be at once seen that the surplus in the way of productions was very great indeed. Many well organised railways are rapidly opening up the interior to the cultivator, and let it be borne in mind that the interior of South Australia is not the desert waste some have imagined. On the contrary, we have here splendid plains, including good soil, and while there are mountainous lands stretching off for hundreds of miles, thickly wooded with the famous eucalyptus, and often enclosing valleys which compare even with those of our own land in its most picturesque recesses. Very much of the scenery is, indeed, of a park-like character, and although intervals of stern sterile tracts intervene, these are seldom the rule, and many of these might yield to artificial irrigation, which, by-the-way, is now being extensively developed in Australia, to neutralise the serious effects of that principal enemy of the Austral husbandman—drought. During the year 1881 the colony exported flour to the value of £837,580, while the breadstuffs sent out were estimated at £2,469,720. When we reflect that the number of male inhabitants of this magnificent region was only 149,530, including those under age, it will be readily admitted that here again production has altogether outstripped population in a marvellous manner, and that in settling these grateful soils we have a very real and practical supplementary addition to our now comparatively insignificant wheat-fields at home.

But we have not yet by any means exhausted the potential food-raising capacity of the continent. Western Australia is a colony but little known or regarded in England, and as at present its very small population is less than 30,000 all told, it does not immediately enter into the calculations of our food importers. Yet it is a region well worth considering, since it includes some truly magnificent expanses—country especially adapted for cereal culture, while settlers only are needed to develope its flocks and herds into proportions that would even exceed the vast pastoral riches of South Australia, Victoria, and New South Wales. The total area is truly enormous, being 1,057,250 square miles, or eight times the size of the United Kingdom, to which, by the way, it lies nearest of all the members of the great Austral group. In 1880 there were nearly 64,000 acres under tillage, and about a third was under wheat, the average yield being 15 bushels to the acre. The live stock included 34,568 horses, 63,719 horned cattle, and 1,231,717 sheep. All the principal flowers and fruits of the world grow, or may be grown, in these fertile lands. The whole range of fruits peculiar to Europe can be reared in full perfection, while the olive and vine flourish exceedingly. The abundance of flowers has resulted in a vast increase of bees; and honey is produced in such quantities as to be locally of little or no value. Very much of the soil is naturally well adapted for farming purposes, and in some quarters there are downs of an extent equal to some European kingdoms, capable of supporting almost countless flocks and herds. The fertility of much of the soil in the vicinity of the watersheds is astounding. Thus, on the Greenhough River, there is a single flat containing some 10,000 acres, which raises 30 bushels of wheat to the acre, and that with culture of a superficial character. In other quarters there are vast forests of the famous jarrah wood. Until of comparatively late years, an idea prevailed that the interior was one awful, absolutely sterile desert, destitute alike of water and of land marks. Happily, Colonel Warburton, and subsequently, Mr. John Forrest, have, by their careful explorations, dispelled to a great extent the fallacy. There are certainly extensive deserts, but these are more like the rind ordinarily is to the pulp of the fruit, than the reverse, as once popularly imagined, and hundreds of miles in the far interior, beautifully undulating grass-grown plains have been discovered analogous to the well-known prairie soil of the far west of North America, where great harvests will some day be reaped by the aid of machinery, when once the civilizing railway has penetrated into these uncropped virgin soils. In effect, the rapid development of the great trans-continental railway is bringing us approximately near to the beginning of what must prove the true golden age of the antipodean agriculturist.

(To be continued.)

NIGHTS WITH A THREE-INCH TELESCOPE.

BY "A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY."

AND now we come to the lovely object, of which Fig. 39 is nothing but a diagram, α Herculis; the contrast between the pronounced orange hue of the large star and the emerald green of the smaller one being perfectly charming. δ Herculis is a somewhat wide and very unequal pair. We insert it here on account of the extraordinary discrepancies which appear in the descriptions of the colour of the companion by various observers at different dates. This is a star which the observer will do well to watch.

Fig. 39. Fig. 40. Fig. 41.

α Herculis. ρ Herculis. 95. Herculis.

ρ Herculis is a close and beautiful double, the colour of the companion being very fine. It is shown in fig. 40. λ Herculis (between δ and μ, map, p. 626, Vol. I.) is only a single star, with nothing but its deep yellow colour to render it at all remarkable. It is inserted here, though, since it may interest the student to look at, or very near, the point in the heavens towards which our entire solar system is moving at the rate of some 422,000 miles per diem. One-third of the way from α Herculis towards Vega (the brilliant star α in Lyra) will be found a widish pair, 200 of Piazzi's XVIIth hour of R. A. It is noticeable for the beautifully-contrasted colours of its unequal components. If we draw an imaginary line in the sky from α Ophiuchi to β Lyræ, and travel 10° along it, we shall arrive at 95 Herculis, a tolerably close star, whose components differ but little in magnitude, though they have been alleged to do so notably in colour. Smyth called them "apple green" and "cherry red." Another observer described them as both golden yellow. At present they appear to us as of a palish yellow, both nearly of the same hue. 95 is represented in fig. 41. μ Herculis, a wide and very unequal pair, presents, as do so many other stars in this constellation, very finely-contrasted colours. 11° from β Lyræ, on line joining this star with α Herculis, lies 100 Herculis, a pretty and easy little pair of equal magnitude. It is shown in fig. 42. Such are a few typical objects among

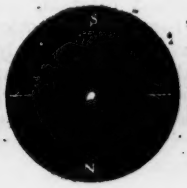
those with which this fine constellation abounds. Purely telescopic pairs fairly swarm in it, and may be picked up everywhere by simply sweeping the sky. At least seven well-determined variable stars, too, are numbered among its constituents; and in addition to the two clusters of stars of which we have given a short description above, it contains two planetary nebulæ and many interesting fields of stars. It will prove a very treasure-house to the incipient observer.

Libra, situated beneath a part of Serpens (*vide* p. 21), need not detain us long. Its two principal stars, α^2 and β, have very distant comites; but can scarcely be legitimately called "double." About 5½° to the south by east of α the observer will find 212 of Piazzi's hour XIV. It is just visible to the naked eye. It forms a pretty but very easy pair with a moderate power. This is really a triple star, but the third component is hopelessly beyond our aperture. μ Libræ is an extremely close pair, but is said to have been seen by Burnham with a 2½-inch achromatic. Its appearance, as exhibited in an English 3-inch telescope, is shown in fig. 43. It is not marked in the map on p. 626, but is a little more than 2° to the north and west of α. About 6° west-south-west of μ Serpentis will be found Struve 1962 Libræ, a pretty and delicate, but not difficult, object. The remaining double stars (of which there are a good many) in this constellation are all invisible to the naked eye. Before quitting it we must look at that beautiful object, 5 of Messier's catalogue—a fine cluster of stars crowded into a nebulous-looking object. This lies nearly 9° to the south-west of α Serpentis, and forms a rudely-equilateral triangle with that star and μ in the same constellation.

Fig. 42.

100 Herculis.

Fig. 43.



μ Libræ.

Fig. 44.

λ Ophiuchi.

Below Hercules, and straggling in and out of Serpens, Libra, Scorpio, and Sagittarius, we find Ophiuchus, or the Serpent-bearer. The Serpent borne by this gentleman we have already described on p. 21. We now turn to its carrier himself. Unlike Hercules, the major part of Ophiuchus appears meagre and barren to the naked eye. It, however, resembles that constellation in being replete with objects of telescopic interest. Beginning with ρ^1, which is, by the way, terribly low down, we find a beautiful close pair of stars, with a pretty contrast between the pale yellow of the larger one and the blue of its companion; the pair forming the apex of a triangle with two other conspicuous stars. λ will tax the observer's powers and those of his instrument to the utmost. This is a binary star, with a period of 234 years; its components are very slightly opening just now. Fig. 44 gives some idea of it as seen as a merely oval object, with a high power under the finest definition. Some 3° north-west of η a new star blazed out in 1848, subsequently fading to practical invisibility in small instruments. This neighbourhood should be watched. 10° due east of Antares will be found 36 Ophiuchi, a pretty and fairly easy pair. It is too close to the horizon, though, for fine definition in these latitudes. 39 will be found 1° north-west of θ in Ophiuchus. It is very nearly as badly situated as the last star. The components are not very close; but their colours are fine. Another star, much better placed, which may be looked at for the colours of its components, is 67, 4½° east-south-east of β Ophiuchi. It is very wide, though. τ, a most interesting binary object, will, like λ, prove a crucial test for the observer. It will need an instrument of the highest class, a high power, a very sharp eye, and an excellent night to do anything with it; and even with these advantages it will only appear, like λ, as a misshapen star. 70 Ophiuchi,

Fig. 45.—70 Ophiuchi.

6° to the east-south-east of β, is an interesting pair, shown in fig. 45. The colour of the smaller star is believed, with some reason, to be variable. It used to be violet or purple, and is now yellowish. Ophiuchus is remarkably rich in nebulous-looking star clusters. As they are not marked in the map on p. 626, our directions for finding them will, we fear, appear somewhat vague. Beginning with 12 Messier, we shall find this about 8° 15′ north-west by west of ε. 10 Messier is nearly half-way between β Libræ and α Aquilæ. Messier 19 lies 7½° due east from Antares; 9 Messier will be found 3° south-east of η Ophiuchi. About 6½° to the south-by-west of γ lies 14 Messier; while, finally, 23 Messier Ophiuchi, a fine cluster, will be found about 5° north-west of μ Sagittarii.

A GHOST STORY.

PREMISING that my personal belief in Ghosts is of the same kind and amount as that which I profess in the existence of the Phœnix or the Hippogriff, I should like to relate an absolutely true story of a circumstance or adventure which occurred to an old friend of my own, for the purpose of eliciting, if possible, some consistent explanation of it from some of your readers who are interested in psychology. I shall disguise the names of the actor (or actors) in the strange history I am about to relate (I have forwarded the real ones to the Editor) but nothing else.

During the first half of the present century, Francis and Horace Jones (two sons of Captain Jones, of the Royal Navy, who was drowned in the St. Lawrence River) emigrated to New Zealand. After undergoing various vicissitudes foreign to the purpose of this narrative, they settled down to farming, and built themselves a log-house at one extremity of a clearing in the bush. The only other occupants of this clearing (for, oddly, the natives never came near it) were, what they called, some Scotch "Shepherds," but who were in reality great sheep-farmers and stock-raisers. Between these Scotchmen and the Joneses an intimacy naturally sprang up. Now one night—and of all nights in the year it was Christmas eve—Horace Jones went over to spend a few hours with these Scotchmen. I need not say that whisky toddy formed a prominent feature in the celebration, and they toasted all those dear to them, who were removed by the semi-circumference of the globe, sang "Auld Lang Syne," and, in fact, had a good deal more than "a wee drap" in their "Ee," when

Horace Jones left to go home. On getting clear of the stockade and out into the bush, his walk was perhaps a thought tortuous, but he kept on as straight as he could go (which was not, perhaps, saying much) in the direction of his own home. He had not, however, proceeded very far, before he became aware that some *thing* was progressing close by his side, going on when he went on, stopping when he stopped. The effect of the whisky toddy began rapidly to evaporate, and pulling himself together he nervously eyed his mysterious companion. He was walking at this time among trees, and the moon was hidden by clouds, so that all he could see with certainty was that whatever, or whoever, it was that was accompanying him, was very tall and of undefined figure. Well, he proceeded in this way, getting every instant more collected, until he came to a clear and open space, the moon at that instant breaking out from behind a cloud. To his dying day, he has often said, he shall never forget the sight which almost made his heart stop, and which rendered him as sober as a judge in an instant. Close beside and almost touching him stood a native, a superb figure of a man, quite six feet high, naked to the waist, but with his head cut off, and the blood shimmering in the moonlight as it trickled down from the stump of his neck which remained! With a shout or shriek Horace Jones turned and ran with all his might towards the Scotchmen's, as being the nearest point of refuge, never daring to turn round and see if his ghastly companion were following him; he battered with his hands at the door on reaching it, and as soon as it was opened fell forward into the house in a fit. When with some difficulty he was resuscitated, he told his entertainers what he had seen, they in their turn remarking as an odd coincidence that, at the same time something appeared to have got among the stock, which became as it were frantic. When, however, Jones calmed down a little, I rather fancy that they had some more whisky toddy. He of course spent the night there. On returning the next morning to his own home, and telling his brother Francis what had happened, he was so unmercifully chaffed, and his supernatural experience was so definitely predicated to be the result of an earthly spirit, that he held his tongue, and began to question whether there really might not be something in that hypothesis. Months passed, everything went on as usual, and he forgot all about it.

About a year afterwards the Joneses wanted a chimney built in their log house, and they called in the aid of some natives to do the work. While paying the chief man, Francis, who spoke Maori like one of themselves, asked him how it was that the natives, while squatting all about the neighbourhood, never came and encamped upon that clearing, which, with a beautiful river running through it, seemed to present a singularly eligible spot for such a purpose. "Well," was the reply, "I will tell you why we never come here. We have a tradition that in ages gone by our tribe was at war with another tribe, and that they used to fight hereabouts" (this Frank Jones has since often told me was probably true, as you could not put a spade into the ground without turning up human bones) "and" went on this naked savage "they say that our chief was treacherously sold to the enemy, who cut off his head, and *that he walks here of a night without his head*, and that is why we never camp upon this clearing."

And then Horace Jones remembered what he had seen on the previous Christmas Eve. F. R. M. S.

[It seems to us the only admissible interpretation of the story is that the native tradition *had* been mentioned, but forgotten, till the stimulus of the whisky brought it to the surface—so to speak. Possibly it had been mentioned during the excitement of some former "bout." Of course, it would be interesting to know by what process of mental trickery the corresponding image was "made up"—possibly from some animal which had run beside Mr. Horace Jones. But the capacity of the excited and whisky-disturbed mind to form such images is amazing.—ED.]

A THEORY OF FORESIGHTS.

OUR esteemed correspondent, "F. T. P." writes to point out that the second of the larger drawings on p. 114, No. 37, is incorrect; instead of the disc representing the bull's-eye being round, it should be distorted by the encroachment of the diffraction fringe upon it, on the right side. This, of course, is the vital point of the whole thing. Unfortunately, our engraver, seeing in the rather rough picture sent him what looked like an ill-drawn disc, corrected the drawing, and made the disc circular, whereas it should have been shaped like the moon when some nine or ten days old, the defect from complete circularity being on the right-hand side. The pictures, unfortunately, did not accompany the proof, or the error would have been detected, "F. T. P.'s" description being very clear. Also on line 6, col. 114, for "fitting" read "being," and in last line but one of the letter, for "image" read "mirage." These corrections should be made, the right side of the lowermost black disc being reduced by a crescent of white (paint or the like) till the breadth of the white fringe on that side is equal to the breadth at top and bottom. "F. T. P.'s" communication is so valuable, and his method so well worth knowing, that we cannot but regret the inaccuracy of the most important diagram, obviously though the text suggests the necessary correction. It is important that all diagrams not drawn precisely as they are meant to be engraved, should have explanatory notes. For instance, we have shown an engraver "F. T. P.'s" later drawings, sent to show how the discs should be, and he tells us that he could certainly represent both the black spots by circular discs.

HOME CURES FOR POISONS.

VEGETABLE POISONS.

OUR purpose in describing the chief vegetable poisons in our last was to indicate rather the effects of specific poisons, and the best method of home cure, than the botanical distinctions of the several poisonous plants. Several correspondents write to point out methods for distinguishing poisonous from non-poisonous varieties; but the subject is too wide to be dealt with in a few scattered notes. Hereafter a paper may be written on that subject specially. It will have to be illustrated, as the technical terms necessarily involved in written descriptions would only be intelligible to botanists.

Two correspondents write to say that Deadly Nightshade is *not* common in our hedges, though Woody Nightshade is; and one "presumes" that Bitter-sweet, or Woody Nightshade (*Solanum Dulcamara*), was mistakenly intended. The description should have shown that Deadly Nightshade (*Atropa Belladonna*) was referred to throughout, and not Woody Nightshade. The word "common" was ill-chosen, however; for though Deadly Nightshade is not unfrequently met with in hedges and thickets in various parts of England, it can hardly be described as commonly

found there. *Woody* Nightshade, on the contrary, is often seen. It should have been added to our list of poisonous plants. It may be known by its zigzag stem, with alternate leaves, the lower lanceolate or cordate, the upper hastate or jagged. The flowers resemble those of the potato, but they are smaller. The berries are red or crimson, and are not unfrequently mistaken by children for red-currants. The taste is bitter at first, then sweetish, whence the names Bitter-sweet and *Dulcamara* (*Dulcis et amara*). The poisonous effects are similar to those produced by *Belladonna Atropa*, and though not so active for equal quantities, whether of berry, root, or leaves, are sufficiently dangerous, resulting even, in some cases, in fatal consequences.

LOWER LIFE FORMS.*

THIS book will be welcomed heartily by students of zoology, because it shows them just the sort of work which is most instructive. The author has not here given a text-book of zoology, but a hand-book for the thorough study of certain typical forms. Most teachers of natural science find so much time and space required for the presentation of the facts on which philosophical discussion is to be based, that little room is left for the investigation of scientific relations resulting from the study of facts. Dr. Brooks shows the student how to acquire a knowledge of the facts for himself. He takes a few types for description; calls the attention of the student to those structural features which he can readily observe for himself; points out by admirably-drawn pictures the methods and results of dissection and microscopical study; and indicates the significance of the observed facts. The complicated figures which accompany most monographs are not given, but the drawings of the author, or made under his direction from nature, have been reproduced by photographic processes. "It is hoped," says the author, "that the practicability and significance of the cuts, as guides to dissection and study, will more than compensate for the artistic finish and technical skill which has been lost by the employment of this method of reproduction." But the apology is not needed; we have seldom seen more effective illustrations. The following are among the subjects dealt with in this excellent hand-book:—The structure of Amoba, Paramœcium, and Vorticella; the Multiplication of Vorticella; Calcareous Sponge; the Starfish; the Sea-Urchin; Earthworms; Leeches; Crabs, Crayfish, and Lobsters; the Anatomy of Cyclops; the Grasshopper; Lamellibranchs; and the Squid (Loligo).

PROFESSOR OWEN ON VIVISECTION.†

ON March 28 last a meeting was held at the Royal College of Physicians, in London, attended by many of the most distinguished medical men of the day, the object being to "bring the legitimate influence of the medical profession more effectually to bear on the promotion of those exact researches in physiology, pathology, and therapeutics, which are essential to sound progress in the healing art." The Master of the Rolls remarked on that occasion, that "it would be most desirable that the public should be informed upon the matters contemplated by the Association." The book before us has been written in response to this wish.

It will probably be useless to commend the careful study of this little book (full of most interesting matter outside its special purpose) to the more sentimental of the anti-vivisectionists, for whom, by-the-way, Professor Owen adopts the title of Bestiarians. But for those anti-vivisectionists who are not prepared to allow a regard (very just in itself) for inferior animals to overrule all other feelings, the study of this treatise will be useful and instructive. They will see how much of the humanity of modern medical and surgical practice is due to the practice which the Bestiarians describe as inhuman. Professor Owen shows that even inquiries not necessarily directed at their outset to pain-preventing discoveries, have led to the relief of an enormous amount of human suffering and untimely death. As a striking example, consider the case of John Hunter's researches into the annual growth and shedding of the antlers of deer. A buck having been put at his disposal, Hunter placed a ligature around the carotid artery supplying the growing antler, on which the pulsations of the formative "velvet" ceased, and the antler began to cool. The buck was released, and examined a week later. To Hunter's surprise the velvet had recovered its warmth, and the growth was proceeding as usual. The buck was thereupon killed (a "fearful piece of cruelty," though the annual hunting and killing of scores for venison is a "noble sport"). He found the canal of the carotid had been obliterated; but sundry ordinarily minute branches sent off below (*i.e.*, between the heart and the ligature) had enlarged, had carried the blood to other capillaries communicating with the carotid above the ligature, and the enlargement of these previously inconspicuous vessels had restored the supply to the cold antler, and with it the power of growth. Take now the other side of the picture. Not long after, a coachman, suffering from poplitcal aneurism (caused by the pressure of the hard margin of the box-seat on the vessels of the ham), lies at Hunter's (now St. George's) Hospital awaiting amputation of the leg, to which operation he has given his consent. Hunter says to him, "If you will let me make a small cut in your thigh, I may save your life and limb both." "God bless you, sir," says the sufferer; "do what you think best, so you put me soon out of this torment." A ligature is thereupon put on the femoral artery, and immediately the tumour ceases to beat and begins to diminish. The patient exclaims that his agony is over. True, the leg begins to chill. Hunter will have no artificial heat applied, only flannels swathed round the foot and leg. In a day the natural warmth begins to return, but not the pulsations in the tumour. The morbid mass grows smaller and smaller, and in six weeks the coachman walked out of the hospital on both legs, cured of his aneurism. This was in 1793. In the years which have elapsed since, how many hundreds have been saved from torture and the risk of death by the application of this method, which substituted a comparatively trifling operation for rarely successful amputation. Even the operation is now usually avoided, pressure being substituted for ligature. And this is but one instance among many. Every one who wishes to gain a just and honest opinion on the vivisection question, should read this interesting work by our veteran naturalist. But those who wish to gain a cheap reputation for tender heartedness should avoid it, lest it convince them, against their will, that their tender mercies are very cruel.

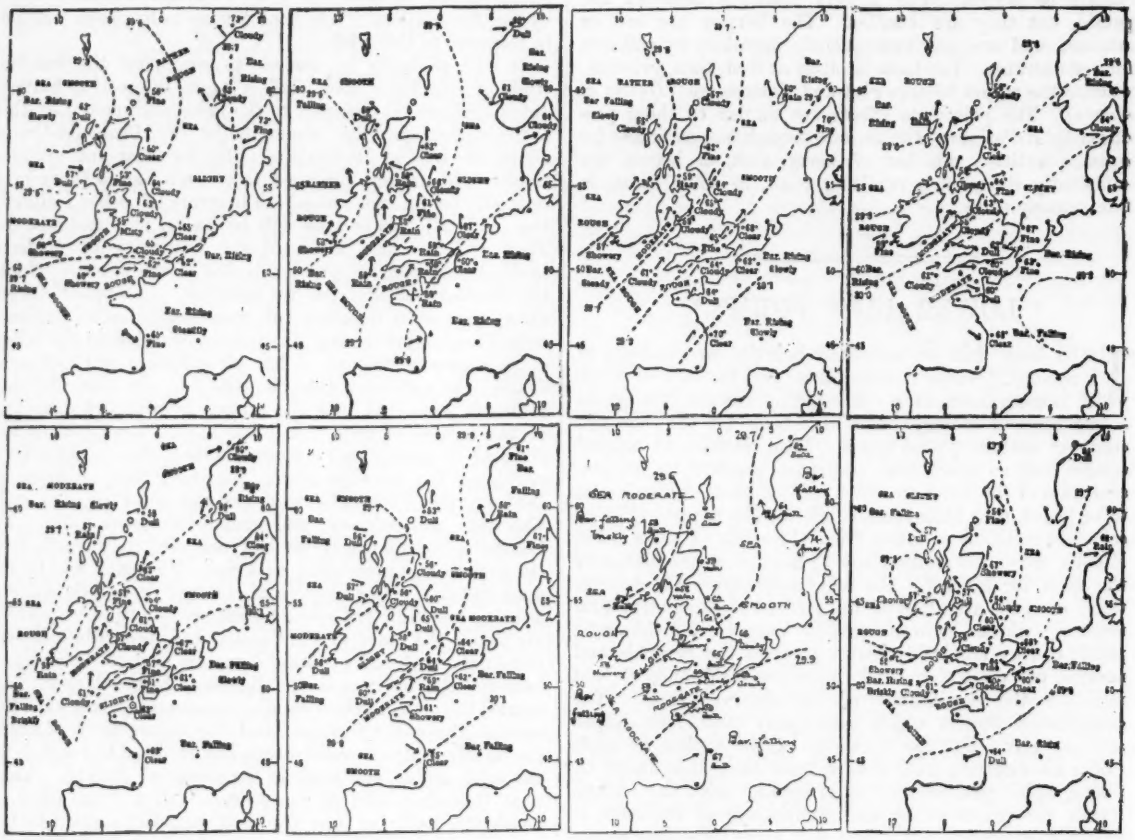
* "Handbook of Invertebrate Zoology, for Labriatines and Seaside Work." By W. K. Brooks, Ph.D., Director of the Chesapeake Zoological Laboratory of the John Hopkin's University.

† "Experimental Physiology, its benefits to Mankind; With an Address on Unveiling the Statue of William Harvey at Folkestone." By Richard Owen, F.R.S., &c. (Longmans & Co., London.)

XUM

WEATHER CHARTS FOR WEEK ENDING SUNDAY, JULY 23.

SUNDAY, 16TH. MONDAY, 17TH. TUESDAY, 18TH. WEDNESDAY, 19TH.



THURSDAY, 20TH. FRIDAY, 21ST. SATURDAY, 22ND. SUNDAY, 23RD.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus:— ⟶, light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

Science and Art Gossip.

IT has been discovered that transitory colour-blindness is produced by a stay of a few hours among snow-fields illuminated by the sun, all artificial lights appearing green for a short time. The exhaustion of the retina for the perception of red is more prolonged than for other colours.

PHILADELPHIA kills her dogs, not by drowning them in a cage, but by introducing carbonic-oxide gas into an apartment which, after the dogs have been driven into it, is made air-tight. One hundred can be killed in this manner at once, and their death is quick and painless.

TOWER CITY, Dakota, has a water supply from a remarkable artesian well. When the earth was penetrated 560 feet, salt water was obtained. Twenty feet further down a gravelly stratum was struck, yielding also salt water. After boring down 604 feet fresh water, mixed with quicksand, came up. Now, from a depth of 675 feet, there is a flow of pure, potable water of steadily increasing quantity.

POPULATION OF JAPAN.—The latest census gives the population of Japan as 36,358,994—males, 18,423,274; females, 17,935,720—an increase of 3,000,000 since the last previous census in 1873. This increase, however, is in part attributed to the growing accuracy in collecting returns, the earlier estimates having been too low. The population of the three principal cities is thus distributed: Tokio, 979,084; Kioto, 830,829; Osaka, 587,998.

THE University at Toronto, Ont., admits women, and in his commencement address Chancellor Blake spoke very favourably of the experiment. In the class of three years' standing there are three women, and in the next younger five, while of the freshmen no less than forty-four are females. Moreover, the girls hold their own against the boys in scholarship, and get plenty of honours. The Chancellor thinks that in a little time female teachers will be introduced.

TWO NEW OCEAN CABLES.—Under the Bill which has passed Congress incorporating the Baltimore and Ohio Cable Company, the railroad company contemplates immediate preparations for laying two ocean cables. It is probable that one point of landing on the American side will be near Boston, or between that city and New York, and the other near Norfolk, Va. The latter cable is likely to be laid *vid* Bermuda and the Azores to the coast of Portugal, and the northern line will probably be laid to England. Preliminary examinations and preparations are in active progress.

INSECT pests, like men, make their way chiefly from east to we With the exception of the grape phylloxera and the Colora potato-beetle, Europe has not received from America any co

XUM

STARS FOR AUGUST

OUR STAR MAP.—The circular boundary of the map represents the horizon. The map shows also the position of the equator and of that portion of the Zodiac now most favourably situated for observation. The names of ninety-nine stars of the first three magnitudes are given below.

On July 30, at 10·30 p.m.
On Aug. 3, at 10·15 p.m.
On Aug. 7, at 10· 0 p.m.
On Aug. 10, at 9·45 p.m.
On Aug. 14, at 9·30 p.m.
On Aug. 18, at 9·15 p.m.
On Aug. 22, at 9· 0 p.m.
On Aug. 25, at 8·45 p.m

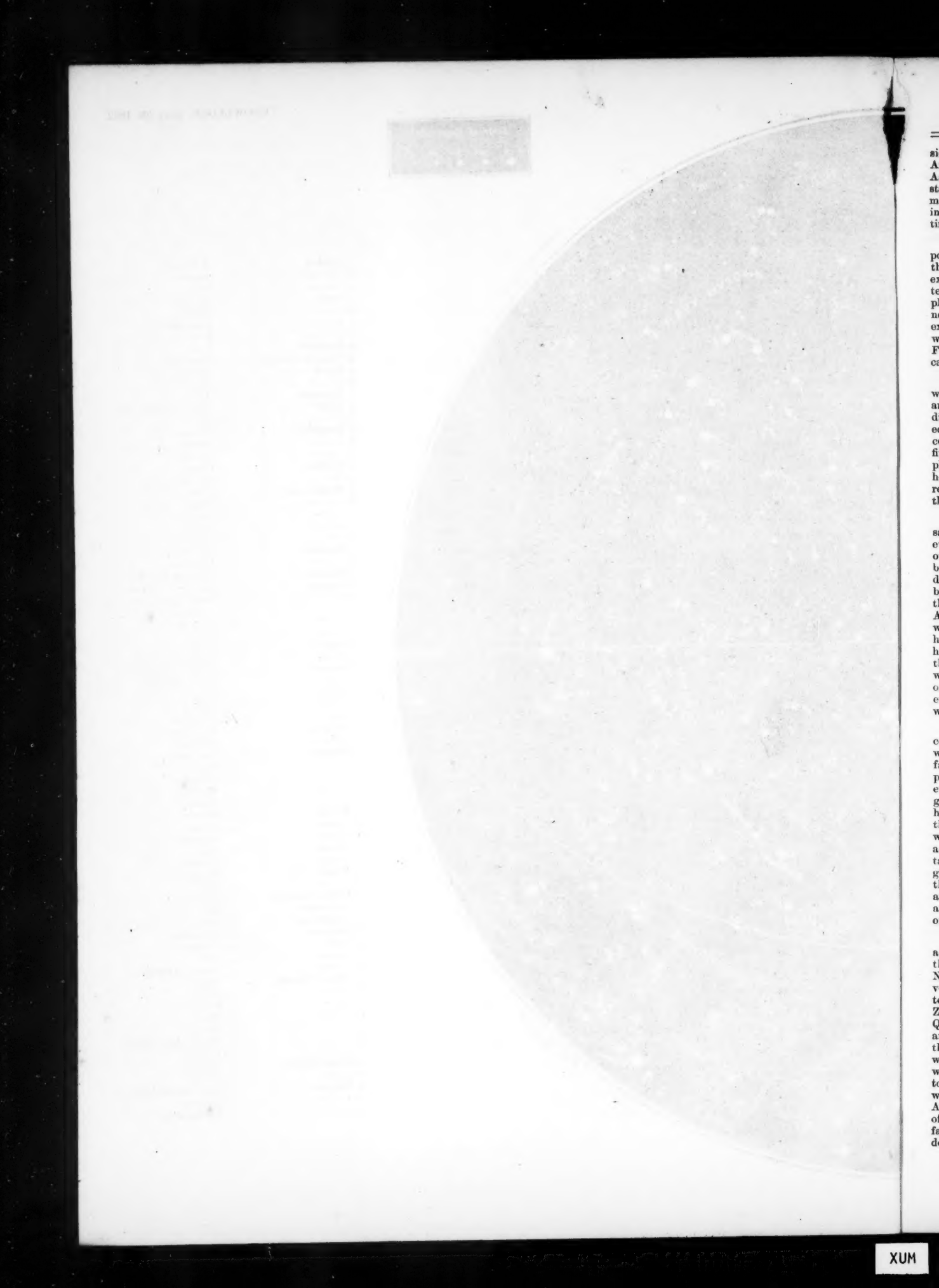
ARABIC NAMES OF STARS.

The following table exhibits the names of all the stars of the first three magnitudes whose names are in common use :—

α Andromedæ	*Alpheratz*
β ———	*Mirach, Mizar*
γ ———	*Almach*
α Aquarii	*Sadalmelik*
β ———	*Sadalsund*
δ ———	*Skat*
α Aquilæ	*Altair*
β ———	*Alshain*
γ ———	*Tarazed*
α Arietis	*Hamal*
β ———	*Sheratan*
γ ———	*Mesartim*
α Aurigæ	*Capella*
β ———	*Menkalinan*
α Boötis	*Arcturus*
β ———	*Nekkar*
ε ———	*Izar, Mizar, Mirach*
η ———	*Muphrid*
α Canum Venat ..	*Cor Corali*
α Canis Majoris ...	*Sirius*
β ——— ...	*Mirzam*
ε ———	*Adara*
α Canis Minoris ...	*Procyon*
β ———	*Gomeisa*
a^2 Capricorni ...	*Secunda Giedi*
δ ———	*Deneb Algiedi*
α Casiopeiæ ...	*Schedar*
β ———	*Chaph*

α	Cephei	*Alderamin*
β		*Alphirk*
γ		*Errai*
α	Ceti	*Menkar*
β		*Diphda*
ζ		*Baten Kaitos*
ο		*Mira*
α	Columbæ	*Phact*
α	Coronæ Borealis	*Alphecca*
α	Corvi	*Alchiba*
δ		*Algores*
α	Crateris	*Alkes*
α	Cygni	*Arided, Denib Adige*
β		*Albireo*
α	Draconis	*Thuban*
β		*Alwaid*
γ		*Etanin*
β	Eridani	*Cursa*
γ		*Zaurac*
α	Geminorum	*Castor*
β		*Pollux*
γ		*Alhena*
δ		*Wasat*
ε		*Mebsuta*
α	Herculis	*Ras Algethi*
β		*Korneforos*
α	Hydræ	*Alphard, Cor Hydræ*
α	Leonis	*Regulus, Cor Leonis*
β		*Deneb Aleet, Denebola*
		Deneb
γ		*Algeiba*
δ		*Zosma*
α	Leporis	*Arneb*
α	Libræ	*Zuben el Genubi*
β		*Zuben el Chamali*
γ		*Zuben Hakrabi*
α	Lyræ	*Vega*
β		*Sheliak*
γ		*Sulaphat*
α	Ophiuchi	*Ras Alhague*
β		*Cebalrai*
α	Orionis	*Betelgeux*
β		*Rigel*
γ		*Bellatrix*
δ		*Mintaka*
ε		*Alnilam*
α	Pegasi	*Markab*
β		*Scheat*
γ		*Algenib*
ε		*Enif*
ζ		*Homan*
α	Persei	*Mirfak*
β		*Algol*
α	Piscis Australis	*Fomalhaut*
ε	Sagittarii	*Kaus Australis*
α	Scorpionis	*Antares, Cor Scorpionis*
α	Serpentis	*Unukalhai*
α	Tauri	*Aldebaran*
β		*Nath*
η		*Alcyone* (Pleiad).
α	Ursæ Majoris	*Dubhe*
β		*Merak*
γ		*Phecda*
ε		*Alioth*
ζ		*Mizar*
η		*Alkaid, Benetnasch*
ι		*Talitha*
α	Ursæ Minoris	*Polaris*
β		*Kochab*
α	Virginis	*Spica Azimech, Spica*
β		*Zavijava*
ε		*Vindemiatrix*

XUM



siderable pest, while innumerable noxious species have crossed th Atlantic from Europe. There is a comparative scarcity, too, of Asiatic insect species on the western seaboard of America, notwithstanding frequent ocean traffic. Spite of great arid plains and lofty mountains, nearly all the insects of Eastern American States, including those from Europe, have found their way across the continent to the fields, orchards, and vineyards of the Pacific States.

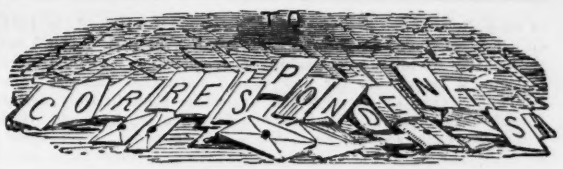
A FREE POSTAL PHOTOGRAPHICAL SOCIETY has been founded as a postal society for the convenience of amateurs in different parts of the country for (1) the circulation of prints, negatives, &c., (2) the exchange of photographs and of information on photographic matters, and for the general advancement of the science and art of photography. This society will in no way interfere with any society now in existence, but will rather tend to the advancement of existing societies by bringing their members more into communication with each other. Entrance fee, 2s. 6d. annual subscription, 5s. Further information and a copy of the rules may be had on application to H. H. Cunningham, Hon. Sec., 7, Fig-tree Court, Temple.

THERE is a weed in the South known as the wild coffee plant, which has caused the planters a good deal of trouble and annoyance, and has consequently been greatly despised. It has recently been discovered that the plant has its use, as rope can be made from it equal to the best hemp, and stronger and finer than jute. The discovery was made by a negro who needed a piece of rope, but could find none. On looking around, his attention was attracted to this plant, and he cut the stalks and treated them in the same manner he had been accustomed to see hemp treated in Kentucky, and the result was a fibre of good length and of surprising strength, which the old man soon converted into rope.

THOUGHT READING.—A Plymouth correspondent (notes the *Echo*) says a strange incident is reported in that town. On Tuesday evening a young man, residing at Devonport, called upon the Editor of a local paper and begged to be informed if any telegrams had been received giving the names of Englishmen killed during the day in Alexandria. He was informed that no such message had been received. He thereupon mentioned that during the afternoon the mother and wife of a petty officer named Revington, serving in Alexandria, had what they regarded as a token of his death. They were sitting together in their house, talking and working, when they heard, or thought they heard, the voice of the absent son and husband say, "Mother!" three times. With forebodings upon them, the brother was at once despatched to the nearest newspaper office, with the result indicated. On Wednesday, however, the relatives of Mr. Revington received a telegram from the Admiralty to the effect that he was shot in the streets of Alexandria on Tuesday, whilst serving on police duty.

THE Salt Lake (Utah) *Herald* says that sea gulls have been uncommonly numerous and active there this spring. Wherever there was a newly-ploughed field, there you could see the gull, and as fast as a furrow was turned up the birds would fly behind the ploughman and commence devouring the insects which were thus exposed to sight. They seemed perfectly fearless. And they have good reason to be fearless here, for the farmer looks upon them as his friend, and they seem to understand fully that he holds them in that light. They fly all about him, within three or four feet, and while perhaps unwilling to submit to being caught, they will allow any other familiarity that can be practised, for they themselves take a great many good-natured liberties. They will not touch grain, or anything that the farmer desires should remain untouched; they only eat the worms and insects which are injurious to the soil and to crops. Only once before have the gulls been so numerous, and that was in 1848, when they saved the settlers from an invasion of mountain crickets.

AMERICAN WATCHES IN NEW ZEALAND.—In a report on the watch and clock trade of New Zealand, Consul Griffin (American) says that, though the introduction of American clocks and watches into New Zealand is comparatively of recent date, they have become so very popular and so general in use that the trade in them bids fair to swell to large proportions. Most of these goods reach New Zealand by way of London. Mr. Bartlett, a leading jeweller of Queen-street, Auckland, said to Mr. Griffin:—"It is difficult to sell an English watch, and as far as the Geneva watches are concerned, they are being fast driven from the market. Everybody seems to want an American watch. I am not prepared to say that American watches are any better than other watches, but it is the fashion to to have them. There is not a boy or a servant girl in the country who can raise five pounds, who does not want to invest it in an American watch." Mr. Bartlett, while acknowledging the popularity of American watches, expresses a decided preference for the old-fashioned hand-made watch, but frankly admits that his customers do not agree with him.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE: *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

AN EFFECTIVE ACCUMULATOR.

[485]—Some time since you published in KNOWLEDGE a description of Sutton's accumulator. A scientific friend, Mr. J. Williams Gifford, of Chard, informs me that he has obtained much better results with an accumulator of which I append a description.

The accumulator consists of a lead trough, coated on the inside with finely divided lead. This is formed from red lead laid on and retained in its place by a lining of canvas, kept close to the sides of the box by wooden stays. In the middle of the lead box is suspended a plate of zinc well amalgamated. It is well thoroughly to amalgamate the lead before laying on the minium, so as to form a thoroughly good connection between the lead and the finely divided lead formed from the minium.

To form the cells, they are filled with sulphuric acid and water, one of acid to nine of water, and are connected in series; the zinc is thus dissolved by the acid, which changes to a zinc sulphate solution, while the lead oxide becomes the before-mentioned finely divided lead. The cells are now ready for use. It is to be distinctly understood that no external battery is to be used to form the cells; their own current is quite sufficient. When formed, they may be charged by a dynamo or battery, but require a motive force of from 5 to 6 volts for each accumulator.

It is well to keep the zinc thoroughly amalgamated; this will ensure the maximum of current given out after a given charge. If the accumulator is only required to last from half to one hour, the minium may be omitted with advantage, and the lead only amalgamated, but if for several hours it must be used, but will slightly increase the internal resistance. The sulphate of zinc solution made in forming the cell gives up its zinc, which is electroplated on the large suspended zinc; the finely divided lead is changed into lead peroxide by the atoms of O from the H_2O split up during action, while the H escapes as bubbles; (hence it is necessary to add a little water from time to time) the solution left when fully charged being $H_2SO_4 + H_2O$. JOHN BROWNING.

PROGENITOR OF VERTEBRATA.

[486]—"W. R." puts a highly interesting question to me, requesting information regarding a statement made by me in an article in *Good Words* for 1875, wherein I say that from personal observation I believed the notochord of the Ascidian larva to be "ventral" in position. I need not say to those readers of KNOWLEDGE who have perused my papers on "Found Links," that if I still maintained this view, the homology or relationship (maintained by evolutionists) of the sea-squirt larva's "notochord" with that of the lancelet could no longer be urged by me. The correspondence of the two structures in sea-squirt and lancelet respectively depends on the recognition of the fact that they are exactly and hereditarily related. The notochord is the same in both; it is dorsal (or lies in the back) in both sea-squirt and vertebrate—such is the evolutionist's stronghold. Now, since 1875, every naturalist has learnt a vast deal respecting "sea-squirt" development and vertebrate homologies. I have great pleasure in fully and freely acknowledging that, although, whilst fairly stating the two views held on the subject in 1875, and whilst leaning to the side of Von Baer, Mecznikow, and others, I have since found reason to change my opinions, and

XUM

to cordially endorse the views of Kowalewsky. Indeed, in 1875, although convinced of the probabilities of evolution, I could not accept the Ascidian relationship of vertebrata. Now, however, I deem it impossible for any candid naturalist (despite some few unbelieving opinions) to do otherwise than to fully accept Kowalewsky's views. Further acquaintance with recent work will make each sceptic, as it made me, an ardent evolutionist; accepting the facts of nature, and the teachings of these facts, as the only true guides to nature's meanings. As a matter of science, I consider the correspondence between the sea-quirts larva's structure and that of the lancelet, to have been so fully made out, that no doubt can be entertained of the relationship I described in my paper on "Found Links." ANDREW WILSON.

APPARENT PARADOX IN PROBABILITIES.

[487]—One of your correspondents stated, referring to some mathematical work (not having the No. of KNOWLEDGE by me I cannot give the exact reference), that if, out of a bag containing an unlimited quantity of tickets, 100 were drawn, and it was found that 50 of them were marked A, 30 B, and 20 C, the chance that the next ticket drawn would be marked with some letter of the alphabet would be $\frac{101}{102}$ (I think), and that the sum of the chances of the ticket being marked A, B, and C, respectively, would be $\frac{103}{104}$. (Perhaps I do not state the fractions exactly right, but, at any rate, the second fraction was greater than the first. Now, on p. 577, you tell me that the fraction expresses the exact chance, not meaning, I suppose, that both the fractions do in fact express the exact chances (for that, as your correspondent pointed out, would involve a paradox, and a paradox in a case of this kind is an impossibility), but rather that the chances were exactly calculated upon the theory erroneously assumed as the basis of the calculation. Even so, the fact that the chances of such an event can be exactly expressed in such a simple form seems to me to be a very curious one, and worthy to rank with two other undoubted facts which have always excited my admiration, namely, that the contents of a sphere are exactly $\frac{2}{3}$ of those of the containing cylinder, and that the area of the parabola is $\frac{2}{3}$ of that of the containing rectangle.

I hope that your articles on probabilities may one day get out of the domain of common sense and the multiplication table, and explore the (to me) unknown region to which this question belongs.
ALGERNON BRAY.

[We do not feel free to carry our papers on probabilities beyond the range they have already had; but our correspondent can, we know, readily work out for himself the following demonstration of the simpler law mentioned above, and afterwards extend the reasoning to the more complex case. Let him then first show that if we represent by $\phi(n^p)$, the sum $1^p+2^p+3^p+\ldots$ to n terms, then, if p white balls have been drawn in succession out of a bag of n balls, all either white or black, but in unknown proportion, the drawn ball being replaced each time, the chance that the next q balls drawn will be white is $\frac{\phi(n^{p+q})}{n^q\,\phi(n^p)}$, an exact proposition. Next let him show that when x is very great $\frac{1^p+2^p+3^p+\ldots+x^p}{(p+1)x^{p+1}}$ is very nearly equal to unity, an approximate proposition, only exact when x is infinite. He will then find no difficulty in showing that if in p cases, from an indefinite number of possible cases, the same event occur, the chance that it will occur in the next q cases is $\frac{p+1}{p+q+1}$
—ED.]

AN ANT TRAGEDY.

[488]—I was reading the other day the interesting article on "Honey Ants" in your journal; possibly the following anecdote in connection with a species of ants in India may be interesting to some of your subscribers.

I can vouch for the facts, as they were told me by the observer himself, a gentleman much interested in natural history.

My friend noticed one day one of this particular tribe of ants on the wall of a room, and put a dab of honey in his path. The ant after examining it carefully, ate away to his heart's content, and then took his way home, to return shortly with twenty or more boon companions. During his absence, my friend purposely removed every trace of the honey left, evidently to the astonishment and discomfiture of the ant who had enjoyed the feast, and decidedly to the chagrin and rage of his companions, who, after apparently listening with disdain to the arguments of their comrade (as shown by the action of his antennæ and the strong "ant language" used on the occasion), suddenly set upon, killed, and devoured their unfortunate and vainly protesting brother.

It certainly would be an effectual method of getting rid of proved human swindlers, but I should be doubly sorry in that case to be one of the "swindled." HENRY J. BUCK.

THE DOUBLE STAR CASTOR.

[489]—As Mr. Herbert Sadler (letter 470, p. 118) appears to be severely exercised in his own mind with reference to my reply concerning Castor, on p. 83, I may perhaps ask for half-a-dozen lines to explain exactly in what sense I gave it. I said, and I repeat, that Castor is *not* regarded by astronomers as a triple star; although in speaking of the 11th mag. Star having "no physical connection with the well-known pair," I certainly expressed myself too strongly. If, however, Mr. Sadler is going to insist that all stars possessing a common proper motion, are double, triple, and so on, then must he, to be consistent, call β, γ, δ, ε and ζ Ursæ Majoris a quintuple star! inasmuch as your own admirable researches, Sir, have shown that these stars are all moving together through space, a result subsequently placed beyond cavil by the independent testimony afforded by the Spectroscope.* The fact is that "double star," "triple star," &c., are forms of expression conveying a perfectly definite meaning to the telescopist, and to include stars more than 60″ apart in either of these categories is to open the door to very ridiculous misdescription. One has only to note how the late Admiral Smyth padded his "Bedford Catalogue" with such objects, to see where we should be landed if we followed out Mr. Sadler's system to its logical conclusion.
A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

[I may note here a rather amusing misprint in Answers to Correspondents, somewhat reminding one of the familiar "Mary Stet" story. In correcting the proof, I substituted, for what had before been the description of the 11th mag. star, the words "small star." This was taken very literally by the compositor—see p. 100, 1st. col., line 7.—R. A. P.]

A VITREOUS GLAZE FOR STONE.

[490]—The following account of Gatakre Hall has been supplied me by Mr. Hubert Smith, of Bridgenorth, and is an extract from a note in his work, published some years ago: "Tent Life with English Gipsies in Norway":—

"Thomas Gatakre was born 1574, of a very old and ancient family, still retaining their ancestral heritage of Gatakre in Shropshire. The former Hall of Gatakre was built of stone, three sides of the exterior of the mansion being entirely covered with a glaze of greenish glass. It has puzzled many to account for the method by which the walls received their vitreous coating, effectually preserving the stone from the action of the weather. The foundation of a building on the estate where the glass is supposed to have been made still retains the name of the "Glass House." We have in our possession some of the stone with its covering of glass, given to us by one of the family. The roof of the mansion is said to have been supported by an enormous oak-tree turned upside down. This interesting relic of former ages was pulled down during the last century, and replaced by the present large and spacious brick-built Hall of the Gat-acres of Gat-acre.

Mr. Hubert Smith has kindly procured me two little samples of the above-mentioned vitreous coated stone, and I find that the glaze is somewhat unevenly laid on the surface, varying in thickness from a thin film to about one-eighth of an inch in thickness.

The stone used was a greyish sandstone, and may have been quarried in the neighbourhood, and was evidently well adapted to withstand almost any amount of heat; and, judging from the small specimens before me, a considerable degree of fire must have been applied to the surface, as that part nearest the glaze is much harder than at a depth of an inch. Mr. Hubert Smith further tells me that all the joints were also covered with the glaze.

I trust that among your numerous scientific readers, some one may be able to suggest a solution of the above puzzle, which is evidently a lost art, and may, if discovered, be of some use in preserving some of our public and private buildings from further decay. J. MILO-GRIFFITH.

* "The Universe and Coming Transits," p. 141. "Pleasant Ways n Science," p. 143, &c.

GOLD IN INDIA.

[491]—"J. S." will, I trust, excuse my answering his question from second-hand information, desirous as he is particularly to obtain the opinion of some one who has been out in India. At present, I am afraid, he will have difficulty in obtaining reliable information on the subject, for Professor Ball is himself rather puzzled owing to the conflicting nature of the evidence as to the extent of the auriferous character of the quartz reefs of India. The opinion, however, of a gentleman who—to use his own words—has done more work (mining) in India than anyone else, besides having had over twenty-five years' experience in Australia and New Zealand as a gold-mining engineer, and of whom Professor Ball has said, before a meeting of the Society of Arts, "As far as we know of him (Mr. H. A. Severn) by reputation, he was a gentleman distinguished from others, who must have reported (*i.e.*, prospects of gold mining) absolutely against their consciences," may be valuable to "J. S."

For fear of taking up too much of the Editor's space, I leave out Mr. Severn's account of the great difficulties encountered by him in transporting mills, capable of crushing 500 tons of quartz per week, through the Wynaad district, which, he says, might, not unfairly, be compared to the rough work of New Zealand; but I give nearly verbatim his account of the Indian quartz. Arriving out there he says, "I was much struck with the great similarity between the auriferous quartz of India and that which I have seen both in Australia and New Zealand; in fact, so far as I could see, the quartz we were to treat was, as nearly as possible, similar in every chemical respect to the best quartz in those countries. I have seen some very fine samples indeed in various parts of the Wynaad district, and several of the lodes were from 6ft. to 14ft. in thickness, with a heavy strike extending over several miles of country." He then proceeds to show the folly of those gentlemen "styling themselves mining engineers," who, seeing a speck of "surface gold in quartz," pound it up, &c., and base all their calculations from that speck; and he then says truly, that "what we want, which will take, I believe, another eighteen months, is to get 500 ft. below the mean level of the country, and there pick up the quartz lodes. I am as certain of getting payable gold in India as I was in working some of the mines in New Zealand. . . . . As a practical man, I can hold out great hopes; but we must get to a greater depth than we are at present working." "J. S." will see from the above, that to really obtain a satisfactory answer to his question, it will be necessary to wait for another year, until the depth of 500 ft. has been reached by the miners. Knowing Mr. Severn personally, I am able to fully bear out Professor Ball's high opinion of him.

F.C.S.

LOCAL WEATHER LORE.

[492]—From time to time I see letters in KNOWLEDGE which indicate that considerable general interest is taken in the subject of weather forecasting. You will therefore, perhaps, be able to find room for a word about a matter intimately connected with that subject.

In a letter printed in the *Times*, and which, I think, was quoted in KNOWLEDGE, I attempted to show where our present system of weather forecasting is defective. The method pursued is wrong in principle, and accordingly it yields unsatisfactory results. If practical proof of what is theoretically evident be wanted, it is only necessary to point to the fact that of the forecasts issued from the Meteorological Office, those for London and neighbourhood are the most accurate, those for the rest of England much less so; while those for Scotland are too often but bad guesses. This does not argue any want of skill on the part of the great Victoria-street functionaries. It only shows that their system is faulty; and it further indicates where the imperfection lies. Weather forecasts, to be as accurate as possible, must be framed by *local* observers.

Let me, very briefly, explain how the daily forecasts are made. At certain hours, at certain stations throughout the British Isles and north of France, certain observations are made. The results are telegraphed to the office in London. By charting the particulars thus obtained, the official in London has a bird's-eye view, so to speak, of the state of the barometer, the temperature, the wind, and the weather prevailing over the British Isles at that particular time. From the chart he infers the presence or approach of a cyclone, or the existence of an "area of high pressure," called an anticyclone. He has then all the available data upon which to base his forecasts. Let us look at one or two of the chances of error. Suppose there are indications of an approaching disturbance to the west of Ireland. The barometer there is falling, the wind is S. and rapidly increasing in force, dense masses of cloud are coming up before the wind. Now, we know what kind of weather characterises, as a general rule, each part of the cyclone, and it would not be a very difficult matter to predict what weather would prevail at the places which are about to be encountered by those different parts; but in order to do so, it is essential for us to know the *size* of the disturbance, the *direction* of its motion, and the *rate* of its progression, and those are precisely the particulars which we can't get. The forecaster only knows that a disturbance *is* approaching, and he must guess all the rest. Then take the case of an anticyclone. If the forecaster has to trust in great part to luck in founding predictions on a cyclone, he has to trust altogether to it when an anticyclone lies over the country. Anything whatever in the shape of weather might very well happen within an area of high pressure, so long as this little disturbance is of local dimensions. Thus it might rain at one place, hail at another, blow at a third, thunder at a fourth, and so on, all without producing the least effect upon the "area of high pressure." It is seen, then, how largely guess-work enters into the calculations of our weather-prophets.

Situated as we are, with about 2,000 miles of ocean in the quarter from which nearly all our disturbances come, this can never well be otherwise. The particulars of extent, direction, and rate of progression, which are so necessary, we cannot hope to obtain with any degree of precision; and so long as they are wanting, forecasts can never be aught but unreliable.

I come now to the other class of weather-phenomena, with which it is the more immediate object of this letter to deal, namely, phenomena related in some way to the circumstance of *place*. And I may say, to begin with, that while, when an area of high pressure is over the country, the weather is *entirely* the result of local agencies, a cyclone may also be locally *modified* by the same factors; so that in reality local meteorology occupies a far more important place than has hitherto been assigned to it.

This letter is already so long that I must refrain from entering into the subject of local weather. What I wish more particularly to point out is, that local meteorology rising in the scale of importance, local weather-lore, which embodies the observations and experience of generations respecting the phenomena peculiar to localities, must rise with it, and that such folk-lore, if carefully collected, would form an invaluable adjunct to the weather chart in framing forecasts. Although I am no believer in the existing administration of the Meteorological Office, I can quite well see that great difficulties stand in the way of the adoption of what Mr. Scott himself holds to be the best system, *i.e.*, the supplementing of the London forecasts based upon general laws by the experience of local officials; but if that plan be impracticable in the meantime, is it not possible to have the weather at each observer's station described in sufficient detail to enable a meteorologist in London, with a topographically-arranged book of weather-wisdom before him, to make at least a better guess at the approaching atmospheric conditions than he otherwise could? Here, again, there is the difficulty presented by the very sparse distribution of observers, but notwithstanding that, I believe some such plan as I have suggested would materially improve the forecasts.

In conclusion, I may say that any of your readers who may come across weather-saws of purely local application, would oblige me by sending them to me (together with the name of the district to which they apply), as I purpose compiling a book of weather folk-lore, arranged according to localities, as soon as I can find time.

J. A. WESTWOOD OLIVER.

HAIR TURNING WHITE.

[493]—I can supplement the experience of "W. E. F." (letter 484, p. 133) by an analogous one of my own. Three years ago I lost an entire estate through a fraudulent agent. This involved a most serious reduction in my establishment; the discharge of servants, putting down carriages, &c., and caused me the most terrible anxiety. I could not sleep for many nights, and, in the result, my hair, which before my trouble was of a dark brown, turned in about ten days as grey as that of a badger. It has never regained its colour up to the instant at which I write. W. N.

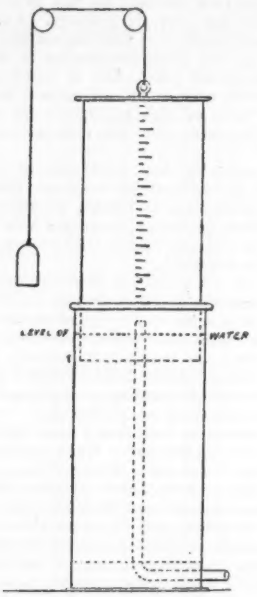
TRICYCLING.

[494]—In a recent deliverance on the subject of Tricycling, by Dr. B. W. Richardson, he emphatically condemned the practice by persons suffering from hernia. I believe that a tolerably reliable estimate places the proportion of male subjects of hernia at one in five or one in six, and as the vast majority of these persons are not disqualified thereby from participation in most kinds of field sports and exercise, it may be useful to enquire why tricycling in particular should be considered pernicious. Some evidence upon this point, based upon actual experience would be more satisfactory than a mere medical dictum. E. A. H.

XUM

AN INSPIROMETER.

[495]—I see from one of your papers on "How to get Strong," that queries as to the "Inspirometer" have been numerous. Would you excuse my mentioning a simple kind of "inspirometer" which I made after I had the pleasure of reading the first paper under this title? The enclosed drawing shows its construction.



It consists of two tin cylinders, the one—15 inches long—sliding inside the other, which is 16 inches in length. Each of them has a flat end, but the end of the larger cylinder is soldered in about one inch from the edge; so that, when placed "on end" on a table, the depth of each cylinder from top to bottom *inside* is the same, viz., 15 inches. The object of having the end of the larger cylinder one inch from the edge, is to allow space for a ¾-inch block-tin tube, which passes through the side of the cylinder, along under the bottom, and, going up through the centre of the bottom into the interior, in a straight upward direction, terminates about half-an-inch from the top of the cylinder. The cylinder is filled with water up to nearly the top of this tube, and the smaller cylinder is then put in, mouth downwards, into the larger one; it would, of course, sink gradually of its own weight, pressing out the air through the tube; but it is fastened to the end of a cord, which, passing over a pulley, has a weight at the other end which keeps it just balanced. I apply my mouth to the lower end of the tube and draw the air out of this upper cylinder, which descends according to the quantity of air that passes from it into my lungs, and that quantity is shown by figures on the outside of the moving cylinder, forming a register of inches, &c., as they (the figures) descend.

This cheap contrivance serves the purpose as well as any delicately-devised and finely-elaborated machine.

I am afraid to trouble you with this communication, but if I am merely obtruding foolishly on your attention, pray excuse me, as you pass this into that receptacle familiar to you, called the "waste basket." I at least remain,—Yours very respectfully,

Glasgow, *July* 1, 1882. AMICUS.

TOBACCO AND CONSUMPTION.

[496]—I cannot see that the prevalence of phthisis in men or women is any argument in favour of or against tobacco smoking, unless it can be shown under what circumstances they live, and to what class they belong. Except in the lower classes, the life of woman is very different to life of man. Personally, whilst a smoker, I had several attacks on my lungs, which I attributed to breathing through the mouth. I rarely smoke now, and always use my nose for breathing purposes. I have never been so free from colds. I will not give my experience of trying to inhale tobacco smoke, as it was disastrous. JOHN ALEX. OLLARD, F.R.M.S.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—*1. No questions asking for scientific information can be answered through the post. 2 Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries. 3. Correspondents should write on one side only of the paper, and put drawings on a separate leaf. 4. Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

FACIEBAT. Suggestions forwarded to author of those papers. Many thanks. Glad the look of Volume I. pleases you.—CUPIDUS COGNOSCERE. Thanks for extract from recent number of *Tit-Bits*: "Prof. Proctor says the sun never lacks a supply of fuel, and that it will retain its energy and perpetuate its beneficent work eternally. We breathe easier now. An impression has got abroad that the sun would burn out in 17,000,000,000,000 years." This joke promises to last about that time. The passage appeared first in an American paper, nearly ten years ago. (2.) You ask, Who is Prof. Proctor? In 1873, about Oct. 6 (having sailed from Liverpool on Oct. 4, and been sick and sorry in the interval) I was first addressed as Professor Proctor by American fellow passengers; and thenceforth, I have been usually so denominated in America and by Americans. They mean it pleasantly, and I like them too well to object,—though I have repeatedly explained to them that not only have I never been a professor, but I have never been a candidate for any professorship, and have on four distinct occasions declined professorships offered to me,—three, on very generous terms, in America (I have a presentiment I shall one of these days accept one of these tempting offers), and one in this country—the Professorship of Astronomy and Mathematics at the Catholic University, Kensington. Thus I am so emphatically non-professorial that I might almost be called anti-professorial. (3.) You ask, What is the meaning of the statement about the sun? There you are "too many for me." I have not the least idea.—TRIA. I refer to periodic changes of the major axis in length, not to variation of the epoch, or to effects of ether.—A. BRITLAND would like to know the date and place of the death of Edward Simpson, known as Flint Jack, the ingenious forger of fossils, flint implements, and Roman antiquities. Perhaps some reader can tell him?—TARANAKI. Thanks. Correction forwarded to writer of those articles.—J. F. SIMPSON. The trouble is as to space; the readings for one place only would be of little use, and not harmonise with the maps. On the other hand, to give two registers daily, fourteen weekly for each datum registered, for a score or so of places, would take much space. Will, however, think of the suggestion. —F. C. S. The subject of your plan is a little outside our purpose.—GRADATIM. (1) You are right. Huxley's statement that the difference between the sidereal and mean solar day proves the earth's revolution is erroneous. It proves only the sun's westwardly motion (along the ecliptic); that this is not due to a real motion of the sun requires independent demonstration. (2) The other mistake about longer axis of ocean ellipsoid pointing moonwards has been repeated so often that one can hardly wonder at its not being corrected in the astronomical parts of a book by a non-mathematical writer. Airy's geometrical proof of the real nature of the tidal motion may hereafter find space here. (3) I do not remember such a passage in Newton's works. I suppose he noticed that as the surface of the water in a bucket at the pole would be paraboloidal, with a definite focus to which light rays would be reflected, there would not only (theoretically) be proof of the earth's rotation, but the means of measuring its rate. The idea is a pretty one. I would suggest substituting mercury, as water at the pole would probably freeze—so, indeed, would mercury, part of the time.—TRIA. After getting $s = -\log(1-t)$, you proceed "if $t=1$, $s=-\infty$; ought it not to be $+\infty$?" Decidedly it ought; and it is. For since $\log.(1-t) = -s$, we have $(1-t) = e^{-s}$; whence when $t=1$, $e^{-s}=0$, $ne^{s}=\infty$. Wherefore $s-\infty$.—G. G. BEAZLEY. Many thanks; have forwarded your note to the publishers.—SUNDEN. (1) You should have referred to number, page, and column. I certainly have not told you that the apparent size of a cloud can vary while its distance (from observer) remains the same. (Distance from earth, perhaps.) I do not remember answering about any such subject. (2) What *can* you mean by saying that I "seem to lose no opportunity of exhibiting," &c., &c.? Where has any such feeling been shown *once* even in these pages? If you choose to regard every scientific statement which you cannot reconcile with "&c.," as an exhibition of "&c., &c.," that is not my fault. But you should not misrepresent matters. For my own part, I find readers like yourself lose no opportunity of exhibiting *their* views about &c., &c. (3) The theory you refer to is preposterous; it is also an old one, long since disposed of.—G. ST. CLAIR. How can I give any opinion about

your theory till I know what it is? From your seeming to regard apparent proximity to the sun as evidence of real proximity, I feel doubtful as to your power to solve what astronomers have long regarded as one of the most perplexing problems presented to them. But all things are possible. Thanks for pamphlet.—J. A. OLLARD. It never occurred to me to add a likeness of "the editor" to Vol. I. Whenever I see my likeness (?) in magazines, &c., I find myself saying (with the little old woman of nursery fame) "Sure this isn't I?"—H. F. W. I know of no scientific men who believe in lunar influence on the weather. Many sailors and agriculturists do, just as many confirmed card-players believe in all sorts of absurdities about luck. Odd coincidences, not directed by systematic observation, suggest these false and fanciful notions. Not one of the regular moon rules has ever stood a year's steady testing.—T. A. That water may be decomposed by electricity is well known: but that when large masses of cloud are charged with electricity the water in the cloud is so decomposed is not known, and that the atmosphere around such a cloud comes to contain hydrogen and oxygen in the right proportions for explosion is altogether impossible. Even as an acoustic phenomenon, it is only possible to explain thunder as produced by the electric discharge as—in less than the thousandth of a second—it traverses many miles of air. I share your admiration for a thunderstorm; and I doubt whether there is the slightest appreciable increase of danger when we enjoy the grandeur of the storm instead of shrinking into backrooms or cellars. In most cases, too, death by lightning is absolutely painless. The flash is not even seen; for the optic nerve takes hundreds of times longer to carry to the brain the news of the flash than the flash takes to destroy life throughout the whole body.—AN EDINBURGH SUBSCRIBER. In this number appears an account, illustrated, of an inspirometer invented and described by a correspondent.—H. ASKEW. You are among those to whom an apology is due for long-delayed reply. M. Pasteur is unquestionably a believer in evolution, and recognises the truth of the Darwinian theory as to one of the chief factors in evolution. Probably whoever cited him as an opponent of Darwinism, supposed Darwinism and atheism to be synonymous terms, which, of course, is utterly absurd. There is nothing atheistic in the modern doctrines of evolution any more than there is in the older doctrines. The argument of the narrow-minded runs thus:—"*I* cannot believe in a Deity if I believe in evolution on the large scale, though my faith is not shocked by the growth of a plant or an animal; modern men of science *do* believe in evolution on the large scale, therefore modern men of science are atheists." From this bad logic may be obtained the following syllogism in relation to Pasteur:—

Believers in evolution are atheists.
Pasteur is not an atheist.
∴ Pasteur is not a believer in evolution.

But Pasteur is a believer in evolution, and Pasteur is not an atheist; nay, Pasteur finds himself led to reject atheism, chiefly because he recognises the infinity of the domain of evolution. The God of science, in fine, is Almighty and All-wise; shallow-brained, slope-browed men, of the street-preacher type, therefore denounce science as atheistical, and instead of saying, "I believe in God, Father Almighty, Maker of Heaven and Earth," they din into our ears their wearisome "Thou shalt believe in *my* God," that is, in a God fashioned after their own image. The less cannot contain the greater; no human brain can conceive what God is; science in considering even the least of His works has come upon the unfathomable; but those least of all can conceive of God aright, who praise as God the Idol they have fashioned from their inner selves. Their pretended zeal against science is, in reality, anger at the contempt which Science feels for the puny wooden idol they have made out of their feeble brains. Yet suppose they are honest enough, though blind—or, at the best, bat-eyed.—G. A. STOREY. Later, lathe work may come in for treatment. Just now space forbids; but many thanks.—NEMO wants to learn how looking-glasses are silvered.—JOHN GREENFIELD. Yes; Laplace and Lagrange proved that the planets, so far as gravitation is concerned, may continue moving round the sun for ever. That is very different from saying the universe can last for ever. Your own communication showed that you referred to heating and lighting as well as movement. I am conscious of no irresistible influence causing me to object to "solar rays moving in circles in space." I know only that, so far as telescopic vision has extended, rays of light and heat go straight. Surely it was not very severe to say of a speculation involving the working round of sun-rays in enormous circles that it is rather vague. How large are these circles? In what planes do they lie? Whereabouts are their centres? What turns the rays from their straight course? Why does it make them work in circles and not in some other curves? When they have worked back, why should we not catch them coming that way towards the sun instead of always seeming to come from the sun? Such are a few of the questions which occurred to me as I wrote the words, "rather vague."—W. B. WICKEN. Thanks; but luminous paint is not available for presswork at 74 & 75, Great Queen-street. Will insert your other letter on tobacco and consumption if can find room; but already, before the last fortnight's letters even touched, we had five or six pages of correspondence standing over.—C. C., JUN. I do not know why gooseberry jelly changes colour during the second boiling. Some reader may be able to tell us.—A. SMITH. Your remarks about Great Pyramid too vague for any use. I hear with interest that Prof. Piazza—usually called Piazzi-Smyth—has disproved the tomb theory for the Great Pyramids. That he had tried to, I knew; that he had done so is news indeed. For one who writes rather dogmatically (though you rather condemn the Pyramidalist's coincidences than any I have insisted upon), your other question is rather mild. Have you really been "bothered a great while" by the difficulty of finding the vertical angle of a cone formed from a sector of given angle? Let r be the radius (which will presently disappear), a the angle of the sector, which may be anything short of 2π, then the arc of the sector is ra, and as this forms the circumference of the base of cone, we have radius of base $= r\frac{a}{2\pi}$. Now the slant side is r. Hence the sine of half the vertical angle, which of course is (radius of base) ÷ (slant side) $= \frac{a}{2\pi}$; so that, knowing this ratio, and expressing it as a decimal fraction, you can at once obtain from a table of natural sines the semi-angle of the vertex.—W. W. The points of the compass marked in my monthly star-maps have relation to the earth only. The star-map shows what stars lie to the north, east, south, or west of a terrestrial observer; which stars high up, which low down, and so forth. The maps tell nothing of the position of the earth in space. Your "plane of the heavens" is fully as mysterious as your "celestial compass." If you ask towards what point on the star sphere the earth is moving at any time, I can answer. The earth is always moving towards that point on the ecliptic which lies 90 degrees (or one quadrant) behind the place of the sun at the moment. Thus on or about June 20 the sun is 90 degrees in longitude from the first point of Aries. At that moment, then, the earth is travelling towards the first point of Aries. "Whitaker's Almanac" (a most excellent work) and any star-maps showing the ecliptic and marking the longitude along it (as my "Library Star Atlas," for instance, or the smaller "Star Atlas") will serve to indicate the point towards which the earth is at the moment travelling. Thus at the hour of writing, July 22, at about noon, "Whitaker's Almanack" (p. 42) shows that the sun's right ascension is 8h. 6m. 43s. Turning to one of my atlases, I find this point to lie very near the first point of Leo, marked in the map with a lion's tail and also with the number 120 degrees. (This is in Map VI.) Going back 90 degrees along the ecliptic, which, as the border numbers show, carries us to Map IV., and thence into Map II., I find that the earth is now travelling towards a point of the star-sphere near the first point of Taurus, lying near the place where the three constellations, Aries, Pisces, and Cetus, meet.—W. WILSON, LL.D., &c. I cannot at the moment find a passage I noted in which Mitchel (not Mitchell) confounds the parallelogram of velocities (a kinematical) with the parallelogram of forces (a statical), law. But in looking for it, I came (at p. 135 of his "Orbs of Heaven") across a passage where he confounds the latter with the second law of motion (a dynamical law). His account of the so-called centrifugal force on p. 137 is as unsound as Joyce's. The supposition of two forces mutually destroying or counterbalancing each other, where in reality there is but one force causing the body to deviate from the straight line in which it is travelling and would otherwise continue to travel, is essentially unsound. The account of Newton's demonstration of the law of gravitation is full of mistakes. The account of pendulum experiments for showing that the force of gravity is exerted by all the particles of the earth's globe (pp. 148 and 149) is altogether misleading,—utterly valueless, in fact; while precession and nutation, the most effective proofs, are left entirely unnoticed.—W. M. I rather like the idea of a paradox column. The study of paradoxers' absurdities serves some useful purposes. I have often noticed that the misapprehensions which cause a Newton Crosland, a Hampden, a Parallax, and such folks, to bud forth into new and nonsensical theories, are really entertained, though without leading to so preposterous a result, by many well-educated persons, who have studied scientific matters insufficiently. —W. G. We cannot well do sums, so many are sent us, and many times as many would be sent if we worked all. Then those you send are so elementary. With regard to the last, involving a difficulty, note that the equation $(1-x)^{-1} = 1+x+x^2+x^3$

+ &c., can only be regarded as correct when the series on the right is convergent. It is not so when x is greater than unity. The real equation is—

$$\frac{1}{(1-x)} = 1 + x + x^2 + \&c. + x^n + \frac{x^{n+1}}{(1- \quad)}$$

the last term of which can be neglected when x is less than 1 and n is taken indefinitely large, but can by no means be neglected when x is greater than 1. For instance, when $x=2$, this equation becomes—

$$\frac{1}{1-2} = -1 = 1 + 2 + 4 + \ldots + 2^n - 2^{n+1}$$

where the last term exceeds in absolute value by unity all the other terms taken together.—JESSIE BOYCE. Not the ellipticity alone, but that and inclination of sun's path to ecliptic explain the observed peculiarity—the so-called equation of time. It is not easy to explain the peculiarity without diagrams. May one of these days find space for an illustrated account in these columns. —F. C. GREEN. The explanation of the tides to which you refer, repeated so often—given not only by Mr. Chambers and others non-mathematical, but by Mr. Christie, the Astronomer Royal,—is entirely incorrect. It may be compared with *this*, as an explanation of the reeling of an inclined top,—"Gravity acting on an inclined top, causes it to topple over," the thing to be explained being why the top does *not* topple over. Ocean Tides will form a good subject for a future paper in KNOWLEDGE, but though Time and Tide wait for no man, those tides must wait for Time. Just now we are tied to time and space.—W. CAVE THOMAS. Thanks; will try to find room.—A SCEPTIC. Scepticism of *that* sort has done more to foster superstition than the stupidest credulity. Take mesmerism as an example. There is something in the phenomena observed, though not what charlatans claimed; the credulous accept pretty nearly all; but the foolish sort of sceptic runs about proclaiming there is nothing in it: he is shown that unmistakably there *is* something in it; forthwith he runs about proclaiming, just as foolishly, full faith in all the absurdities claimed by professional mesmerists. If you want not to be led astray by the untruths told about Thought Reading, do not mislead yourself by the supposition that there is nothing to be explained. Men like Carpenter and others, who have done more than any to take the ground from under tricksters, in psychological and so-called spiritual matters, may be much more safely followed in what they *admit*, than the vulgarist you quote in what (knowing nothing) he rejects. Real science has never encouraged a spirit of *Incredulity*, though placing *Doubt* in the chief place among the virtues. Show me a man thoroughly incredulous, and I will show you (without going very far) one who is on the way to be most thoroughly deceived.

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. V.

BY RICHARD A. PROCTOR.

IT may be well to apply the method already used to determine the differential coefficient of $\sin x$, to the other simple trigonometrical functions; for not only does the method indicate well what a differential coefficient is, but as all these functions are dealt with in the same way, the memory is aided to retain all their differential coefficients.

As before, we use the circular measure for angles, and regard radius as unity. The construction of the figure is obvious.

Put arc $AB = x$, $Bb = \Delta x$.

Then we have seen that if

$$y = \sin x; \quad \frac{dy}{dx} = \cos x.$$

Put now $y = \cos x = Om$,—radius being unity.

$\Delta y = \cos(x + \Delta x) - \cos x = Ok - Om = -km$

$\therefore \frac{\Delta y}{\Delta x} = -\frac{km}{Bb} = -\frac{lB}{Bb}$; and when Δx and Δy are both indefinitely small, we have $\frac{lB}{Bb} = \frac{Bm}{OB} = \sin x$.

$\therefore$ when $y = \cos x$; $\frac{dy}{dx} = -\sin x$.

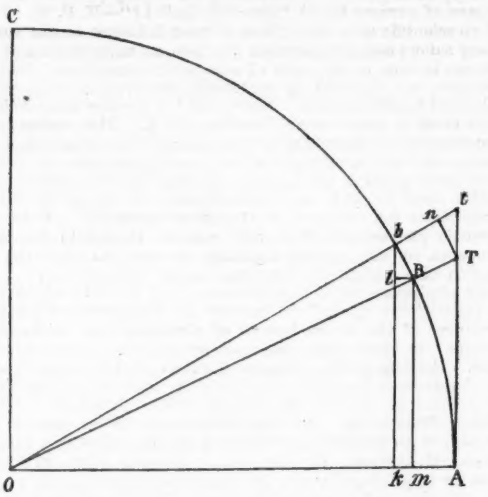
Put next $y = \tan x = AT$. Describe arc Tn about O as centre.

Then $\Delta y = \tan(x + \Delta x) - \tan x = tA - TA = Tt$.

$\therefore \frac{\Delta y}{\Delta x} = \frac{Tt}{Bb} = \frac{Tt}{Tn} \cdot \frac{Tn}{Bb} = \frac{Tt}{Tn} \cdot \frac{TO}{BO}$; and when Δx and Δy are both indefinitely small, we have $\frac{Tt}{Tn} = \frac{OB}{Om} = \sec x$;

and $\frac{TO}{BO} = \frac{TO}{OA} = \sec x$. So that when

$y = \tan x$, $\frac{dy}{dx} = \sec^2 x = \frac{1}{\cos^2 x}$



When $y = \cot x$, we have a precisely similar construction, but we may here conveniently use the same construction which has given us $\tan x$ to give us $\cot x$. For this purpose we set OC at right angles to OA and call the arc Cb, x; and bB, Δx. Then we get At for $\tan x$ and AT for $\tan(x + \Delta x)$. So that we have the same difference Tt, only in this case it is a diminution instead of an increase. We have also, $\frac{TO}{BO} = \frac{TO}{OA} = \sec BA = \operatorname{cosec} CB = \operatorname{cosec} x$ (when Bb vanishes). Hence

when $y = \cot x$; $\frac{dy}{dx} = -\operatorname{cosec}^2 x = -\frac{1}{\sin^2 x}$.

Next take $y = \sec x = OT$. Then

$\Delta y = \sec(x + \Delta x) - \sec x = Ot - OT = nt$

$\therefore \frac{\Delta y}{\Delta x} = \frac{nt}{Bb} = \frac{nt}{Tn} \cdot \frac{Tn}{Bb}$; and when Δx and Δy are both indefinitely small, we have $\frac{nT}{Tn} = \frac{AT}{OA} = \tan x$; while $\frac{nT}{Bb}$ as before $= \sec x$. So that, when

$$y = \sec x; \quad \frac{dy}{dx} = \tan x \cdot \sec x = \frac{\sin x}{\cos^2 x}$$

And similarly, calling COb, x, as in dealing with cot., we find when

$$y = \operatorname{cosec} x; \quad \frac{dy}{dx} = -\cot x \cdot \operatorname{cosec} x = -\frac{\cos x}{\sin^2 x}$$

The student should have the differential co-efficients of the six simple trigonometrical functions at his fingers' ends, as they are constantly wanted. The six functions are here collected into the three which have positive differential coefficients (for arcs less than a quadrant), the sine, tangent, and secant; and those which have negative differential co-efficients, the cosine, the cotangent, and cosecant.

If $y = \sin x$; $\frac{dy}{dx} = \cos x$	If $y = \cos x$; $\frac{dy}{dx} = -\sin x$
$y = \tan x$; $\frac{dy}{dx} = \frac{1}{\cos^2 x}$	$y = \cot x$; $\frac{dy}{dx} = -\frac{1}{\sin^2 x}$
$y = \sec x$; $\frac{dy}{dx} = \frac{\sin x}{\cos^2 x}$	$y = \operatorname{cosec} x$; $\frac{dy}{dx} = -\frac{\cos x}{\sin^2 x}$

Let us next try the inverse trigonometrical functions, and see whether they admit of similar treatment.

Take $y = \sin^{-1} x$. Then in our figure we may represent y by arc BA, whose sin is Bm, so that Bm represents x

Thus $y = BA$ $\quad x = Bm$

Put $bl = \Delta x$ so that $(x + \Delta x) = bk$

Then $\Delta y = \sin^{-1}(x + \Delta x) - \sin^{-1} \Delta x$

$= \text{arc } Ab - \text{arc } AB$

$= Bb$

$\therefore \quad \frac{\Delta y}{\Delta x} = \frac{B\beta}{\beta l}$. Now when Δy and Δx are both indefinitely small $\frac{B\beta}{\beta l} = \frac{BO}{Om} = \sec y$. Hence when $y = \sin^{-1} x$; $\frac{dy}{dy} = \sec y = \frac{1}{\sqrt{1-\sin^2 y}} = \frac{1}{\sqrt{1-x^2}}$.

Applying a similar method for the other simple inverse functions, we find—

If $y = \cos^{-1} x$; $\frac{dy}{dx} = -\operatorname{cosec} y = \frac{-1}{\sqrt{1-x^2}}$

If $y = \tan^{-1} x$; $\frac{dy}{dx} = \cos^2 y = \frac{1}{1+x^2}$

If $y = \cot^{-1} x$; $\frac{dy}{dx} = -\sin^2 y = \frac{-1}{1+x^2}$

If $y = \sec^{-1} x$; $\frac{dy}{dx} = \frac{\cos^2 y}{\sin y} = \frac{1}{x\sqrt{x^2-1}}$

If $y = \operatorname{cosec}^{-1} x$; $\frac{dy}{dx} = -\frac{\sin^2 y}{\cos y} = \frac{-1}{x\sqrt{x^2-1}}$

The student will find no trouble whatever in obtaining any of these results. He will find in every case, on making the geometrical construction (or examining that already made, for the figure illustrates all the cases) that the value of $\frac{\Delta y}{\Delta x}$ in the case of an inverse function is the reciprocal of the value of $\frac{\Delta y}{\Delta x}$ in the case of the corresponding direct function. For instance, in dealing with $y = \sin^{-1} x$, we found $\frac{\Delta y}{\Delta x}$ to be $\frac{B\beta}{\beta l}$, whereas in dealing with $y = \sin^{-1} x$, we found $\frac{\Delta y}{\Delta x} = \frac{\beta l}{B\beta}$. This was to be expected, when we consider that to say $y = \sin^{-1} x$ is the same as to say $x = \sin y$, so that x and y are simply interchanged, in passing from the consideration of a direct function to the consideration of the corresponding inverse function. Nevertheless, it would not be sound at this stage of our inquiry to determine $\frac{dy}{dx}$ from this consideration only. We shall hereafter show under what limitations it may be assumed that $\frac{dy}{dx}$ is the reciprocal of $\frac{dx}{dy}$. At present we have to regard $\frac{dy}{dx}$ as a single expression. It is derived from $\frac{\Delta y}{\Delta x}$ by supposing Δy and Δx to diminish indefinitely. Now, when Δy has any definite value, and therefore Δx a definite value, it is of course true that $\frac{\Delta y}{\Delta x}$ is the reciprocal of $\frac{\Delta x}{\Delta y}$; but we must not assume that *of necessity* the value to which $\frac{\Delta y}{\Delta x}$ tends with the indefinite diminution of Δy and Δx is the reciprocal of the value to which $\frac{\Delta x}{\Delta y}$ tends under the same conditions. This would be assuming that we can treat dx and dy as themselves definite quantities, whereas they are in reality indefinite, though they bear to each other a definite relation. It would matter very little so far as the dx and dy of the simple $\frac{dy}{dx}$ are concerned, that we should treat these as separable quantities; but as we advance with the calculus we find occasion to differentiate differential coefficients, and we are led to the use of such forms as $\frac{d^2y}{dx^2}$, $\frac{d^3y}{dx^3}$, &c.; and it would be altogether inadmissible to regard dx^2 and dx^3 of these expressions as if they were the square and cube of the dx in the expression $\frac{dy}{dx}$.

Of course when, after starting from, say, the statement

$$y = \sec^{-1} x$$

we find $\frac{dy}{dx} = \frac{\cos^2 y}{\sin y}$, it is easy to express this result in terms of x; for we have $x = \sec y$. So that

$$\cos y = \frac{1}{x} \text{ and } \sin y = \sqrt{1-\frac{1}{x^2}}$$

I might here give some examples illustrating the application of the differential calculus—with the coefficients already determined—to various problems of interest. But it will be well first to get over so much elementary ground as is involved in the determination of rules for differentiating all expressions whatever. For then we can take a much more varied range of examples than we could by limiting ourselves to the application of what we have already learned. It is seldom in physical questions that we are limited to simple trignometrical functions, and we could scarcely advance half-a-dozen steps without feeling the necessity of rules for finding the differential coefficients of complex functions and functions of functions. Indeed we should have found the use of such rules in simplifying what we have already done, only that it seemed well to have a few examples of the process of obtaining a differential coefficient directly. Otherwise when we had to consider, say, $y = \sec x$; we might have regarded y as a function of $\cos x$, and proceeded from $y = \frac{1}{\cos x}$ to write down the differential coefficient. Again we might have written, for $y = \tan x$

$$y = \sin x \,.\, \sec x$$

and at once written down $\frac{dy}{dx}$, if we had the rules, which I shall proceed to examine and establish (as far as is necessary in such elementary papers as these) in my next. Then we can proceed to discuss a few problems which will not only show the great value of the calculus, but also illustrate the real meaning of what we have thus far done.

I may, however, here pause to note that the reader must not allow himself to be mystified by the use of such an expression as differential co-efficient, a term which might seem expressly devised to deter the young mathematician from the study of the calculus, as implying that it cannot possibly be of any practical use,—at any rate, in simple problems. For what idea of utility does the expression "differential co-efficient" convey? and why should an expression be employed really belonging to a matter with which elementary applications of the calculus are in no way concerned?—the expansion of sundry functions in the form of series, of which what we are calling the differential co-efficient is one of the co-efficients. What the young student has to bear in mind is that what (to avoid the invention of new terms) we call the differential co-efficient is in reality a quantity indicating the rate at which whatever function—simple or complex—we want to deal with, changes with the change of the variable it involves. When we consider how many problems depend on such changes and cannot possibly be dealt with unless we can determine their effects and limits, the importance of a calculus devised for this purpose will be at once obvious. We shall very soon be able to show this, for we shall very soon have completed our inquiry into methods by which the rate of increase of any quantity whatever, as its variable increases, can be determined.

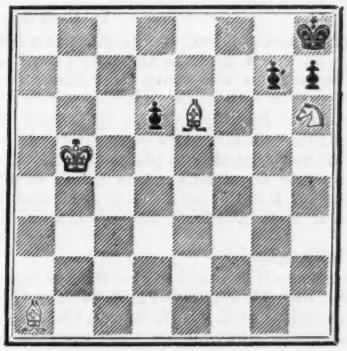
Our Chess Column.

By MEPHISTO.

PROBLEM No. 48.

By H. A. N.

BLACK.



WHITE.

White to play and mate in three moves.
(An ingenious conception.)

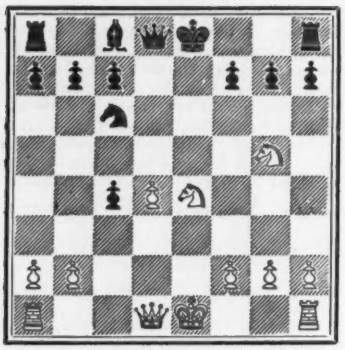
XUM

GAMES BY CORRESPONDENCE.

(*Continued from p. 138*)

Position after Black 10th move, P takes B:—

BLACK (Chief Editor).



WHITE (Chess Editor).

We are pleased to find that our discursive games find favour with our readers. We have received several communications, amongst which is the following letter, having reference to the line of play suggested by our correspondent Leonard P. Rees:—

"Referring to the Diagram, you suggest that 10. B to B4 is Black's best reply, and that if White ventures 11. Kt takes BP he will lose a piece (followed by 12. Q to B3, likewise suggested by our correspondent.—ED.) But suppose after

11. Kt takes KBP — 11. K takes Kt
12. Kt to Kt3

I do not see that White need lose a piece, although after

12. P takes B
13. Kt takes B — 13. KR to Ksq(ch)
14. Kt to K3

Black can win a Pawn,

14. Kt takes QP

but by 15. Q to R5(ch) — 15. K to Ktsq
16. Castles Q side

White would still have a good game. "W. T. PIERCE."

This, no doubt, is quite correct, and we are thankful to our correspondent for his help in our researches. White will soon regain the Pawn, and Black will have great difficulty in getting rid of the weakness created by the pinning of his Knight by the White Rook.

We will now resume the original game.

Black played — 11. Q to K2.

In his note accompanying this move, Chief Editor remarks: "An unsatisfactory defence with K's file free of Pawns, but P to KKt3, to which his reply would doubtless be Q to R6 would leave me the pleasant (?) task of defending KB3 with Queen alone from the inroads of his Knight, backed up by both Rooks presently. I could win Queen's Pawn, still defending the threatened square; but this would make matters worse, bringing his Queen's Rook at once into command of Queen's file." White replied with

12. Castles QR,

which is obviously best, as it brings the QR on Q's file, while the KR is free to play to K(sq.) The answer was

12. B. to B4.

This is a natural sort of move, as it might enable Black to Castle on both sides, as the B protects the KRP; but Black is rather oppressed. The note to this move is, "Where is safety to be found? This move a little earlier might have saved me, but now it comes too late. Possibly at move 10, instead of P takes B, B to QB4 might have made Black's game safe." It must be borne in mind that White threatens P to Q5, and Q6, &c. For that reason 12. P to KKt3 would be of no avail, as Queen would play to R6. Instead of playing P to Q5, for which a good deal might be said, there seemed a more attacking line open, which Chess Editor adopted.

13. Kt to Q6 (ch.)

This move looks as if it ought to give White a superiority, for if 13. Q takes Kt, then 14. Q takes BP(ch). 14. K to Qsq. 15. Q takes B with a tremendous pull. If K moves, Black loses the Bishop. Seeing, then, there is nothing better, there remained no other reply but

13. P takes Kt

with the following note:—"This followed by Kt to K4, and B to Kt3, when for a moment a white Pawn occupies his King's file, seems the best course. But very bad is the best."

14. KR to Ksq — 14. Kt to K4

with the following note by Chief Editor:—"Probably it would lead to a more prolonged defence to take the Rook, although the odds in force against Black would not be great, and his power of developing his game somewhat increased. Such a course against Mephisto would be equivalent to resigning at once." As after Q takes R White will retake with a check, that course would be very unsatisfactory, as this would be followed up by either Q takes BP or Kt takes BP in both cases White would win at least another piece.

15. P takes Kt — 15. B to Kt3

We certainly think that Black could have minimised White's advantage by Castling KR; moreover, the black Pawn on B5 which might be supported by the QR, would have become troublesome. Black, however, did not avail himself of this opportunity for turning the tables on White, but played

15. B to Kt3

to which the reply was

16. P takes P — 16. B takes Q
17. R takes Q(ch) — 17. K to Bsq
18. P to KKt4.

This move is more risky than QR to Ksq, which was, perhaps, White's simplest course.

18. B to Kt3.

B takes P would have been unsatisfactory on accoun of R takes BP (ch); but we think that 18. P to KR3 would have given Black a much better defence than the move in the text.

19. R to Q4.

With a covered design not, of course, to take the QP, but anticipating Black's next move

19. P to KR3.

20. Kt takes BP.

If now 20. B takes Kt then R to B4, with the prospect of getting both Rooks on the seventh file, which has rightly been called the "spot-stroke," and also the advanced QP. Chief Editor thereupon resigned.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

W. T. Pierce.—Thanks for communication. You had an obviously won game by Q takes BP, as you suggest in your letter.

Leonard P. Rees.—You are revenged by W. T. P.

J. P.—Solution incorrect. If 1. B to K4. 1. B takes P. 2. Kt to Kt2. 2. B to B2. 3. Kt to B4(ch). 3. K to B4, and there is no mate.

Our Whist Column.

BY "FIVE OF CLUBS."

THE following game is so far artificial that only *B*'s hand was actually left on record, with the score, *A*'s first lead, and the result. At the score of "Three all" *B* must have felt absolutely sure of success; but why, being sure, did he not keep so, by playing the sure game? The case illustrates well the necessity of playing always to the score. The wild signalling of *B* after his mistake, his despairing appeals to his partner to do what *A* never has the chance of doing, are of course little touches thrown in to make the lesson more impressive.

THE HANDS.

A.

Spades—4.
Hearts—7, 5, 4, 2.
Clubs—10, 7, 5, 3, 2.
Diamonds—Kn, 7, 3.

B.

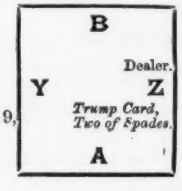
Spades—K, Q, Kn, 10, 9, 8.
Hearts—A, K.
Clubs—A, Q.
Diamonds—8, 5, 2.

Y.

Spades—7, 6, 5, 3.
Hearts—None.
Clubs—Kn, 9, 8, 6, 4.
Diamonds—K,Q,10,6

Z.

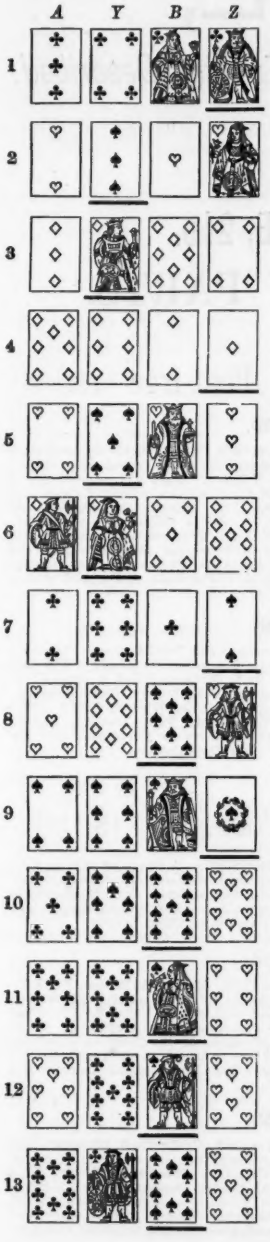
Spades—A, 2.
Hearts—Q, Kn, 10, 9, 8, 6, 3.
Clubs—King.
Diamonds—A, 9, 4.



Score:— *A*, *B*, = 3 / *Y*, *Z*, = 3

THE PLAY.

NOTE.—The card underlined wins the trick, and card below leads next round.



REMARKS, INFERENCES, &c.

A properly leads the penultimate card of his long suit. *B*, finessing according to rule, and overlooking the fact that the case belongs to the exception, deliberately throws away the game.

2. *Z* leads Q, from Q, Kn, 10, &c. *Y* trumps, following Clay's rule not to pass a certain trick unless you see your way to making three by refraining. *B* begins to signal now that he has thrown away the game.

3 and 4. *Y* and *Z* begin to take their tricks in Diamonds, *B* signalling violently in a new suit.

5. *Z* properly forces his partner instead of leading a Diamond. *B* completes his signal in Hearts, naturally.

6 and 7. *Y* having made his Diamond Queen, leads a Club, as very likely to give *Z* a ruff. For *Y* had five Clubs originally, and *A* having led, has four at least. With trick 7 the game is won, whatever honours *B* may hold, for the Ace of trumps will make the necessary eighth trick. For the sake of symmetry we give the remaining rounds as they would probably have been played did the rules of Whist require that all thirteen rounds should be played.

This game illustrates forcibly the necessity of playing to the score. Had *B* played his Ace of Clubs first round, of course the game was won, as he held two by honours in his own hand, and five more tricks certain.

FORCING THE ADVERSARY.—The various ways men take to loose games are truly wonderful. We were looking on at Whist, a short time since, when we noted the following:—*A*, original leader, leads trumps (Clubs), *Z*, fourth player, wins the trick and leads Hearts. *A* has no Hearts, and discards a Spade. *X* wins the trick with the Heart King. He has now two trumps left, four good Diamonds with King, Knave; three Hearts with the Ace and two small Spades. He led a small Diamond. We do not care so much about the Diamond, although, to ordinary mortals it would appear that by leading the Diamond, *X* was leading up to *A*'s declared strength. A lesser light would have said to himself, "If, as I assume, *A*'s strength is in trumps and Diamonds, at any rate I can take care of the Diamonds." After the game was out, we mildly suggested that the Ace of Hearts would have been a strong card to lead, and we received the reply: "Yes, to have it trumped, I suppose, Mr. Clever." *X*, who in his own estimation is a very good player, thought the suggestion of leading the Ace to have it trumped a joke, or the wild invention of a lunatic. Yet we think that the Ace was a very good card to lead. Had *A* ever heard that a player is never too weak to force the strong hand? *X* lost the game by not forcing his adversary at the proper time, but *X* does not know that he lost the game, nor will he ever know it or believe it. The next hand *X* was punished, for he had one of the prettiest hands we ever saw. With Ace, King, Knave, and another trump, a hand full of court cards, but with two Hearts, the first force was got on *X*, and four long Hearts were got in against him. *X* certainly looked astonished, and we think he was, but whether he will ever believe that a force is of use or not we cannot tell. This we do know, he will never lead the Ace of Hearts to be trumped.—*Westminster Papers.*

ANNAMESE SUPERSTITIONS.—Consul Tremlett, in his trade report on Saigon and Cochin China for the past year, gives an interesting account of some of the superstitions which prevail in Annam. It is bad luck for a fish to leap on board a boat; the fish must be cut in two and thrown into the water again, half on either side. The capture of a porpoise is a very bad omen, for he is the messenger of infernal gods. The cries of a "Gecko," if odd, are lucky; if even, the reverse. A bird crying at night is always bad—a presage of death, in fact. This, says Consul Tremlett, is infelicitous; for some birds of the country only cry at night and all night. The squeak of a musk rat announces visits. A cock crowing at noon foretells that the daughters of the house will not turn out well. The tiger is, of course, much dreaded, and the mention of him is interdicted in some districts. Sacrifices of pigs are made at least yearly, with a document attached, which is, or should be, exchanged by the beast for the one sent him the previous year; if the tiger omits this, it is a bad lookout for the village. However, it is all an affair of predestination, so it does not matter much. The water-buffalo is an imaginary animal living in rivers and only coming on shore at night; for all that, he is patent enough in the district, and uncomfortably curious towards Europeans. The Annamese have several kinds of talking-birds—commonly a starling or a raven, who looks after the property while the master is absent, and recounts what has passed when he returns. To meet a serpent in the road is a very bad omen, and whatever business is then in hand must be renounced. As for ghosts and spirits, they abound in Annam—always, everywhere, and of all descriptions.

Contents of KNOWLEDGE *No.* 38.

	PAGE.
Our National Game	123
Found Links. By Dr. Andrew Wilson, F.R.S.E., F.L.S.	124
Stimulants and Study. By the Editor	125
How to Get Strong	125
Photography for Amateurs. Part XI. By A. Brothers, F.R.A.S.	126
Fairy Rings	127
Thought-reading. By the Editor	128
Mathematics and Science. By the Editor	129
Electromania. Part II. By W. Mattieu Williams	129
French Excavations in Assyria	130
Weather Diagram for the Week	131
CORRESPONDENCE: Thought-reading—Rational Dress—A Meteor—Law of Probabilities, Cold Snaps, &c.	132
Answers to Correspondents	134
Science and Art Gossip	135
Our Mathematical Column	136
Our Whist Column	137
Our Chess Column	138

NOTICES.

The Back Numbers of KNOWLEDGE, with the exception of Nos. 1 to 7, are in print, and can be obtained from all booksellers and newsagents, or direct from the Publishers. Should any difficulty arise in obtaining the paper, an application to the Publishers is respectfully requested.

The Title Page and Index to Volume I. price 2d., post-free 2½d.

Binding Cases for Volume I., price 2s. each. Complete copies bound (including Title, Index, and Case) for 3s. each.

The Post-office regulations prevent the transmission of volumes and cases through the post.

The following Monthly Parts of KNOWLEDGE are now to be had (Parts I. and II. being out of print):—

PART III.—(Jan., 1882.) Containing four numbers. Price 10d. Post-free, 1s.
PART IV.—(Feb., 1882.) Containing four numbers. Price 10d. Post-free, 1s.
PART V.—(March, 1882.) Containing five numbers. Price 1s. Post free, 1s. 2d.
PART VI.—(April, 1882.) Containing four numbers. Price 10d. Post-free, 1s.
PART VII.—(May, 1882.) Containing four numbers. Price 10d. Post-free, 1s.
PART VIII.—(June, 1882.) Containing five numbers. Price 1s. Post-free, 1s. 2d.

Subscribers wishing to complete their Sets are advised to make early application to the Publishers, as no further reprints will be ordered.

TERMS OF SUBSCRIPTION.

The terms of Annual Subscription to the weekly numbers of KNOWLEDGE are as follows:—

	s.	d.
To any address in the United Kingdom	10	10
To the Continent, Australia, New Zealand, South Africa & Canada	13	0
To the United States of America	$3.25. or 13	0
To the East Indies, China, &c. (*vid* Brindisi)	15	2

All subscriptions are payable in advance.

P. O. Orders and cheques should be made payable to the Publishers, MESSRS. WYMAN & SONS, London, at the High Holborn District Post-office.

Agent for America—C. S. Carter, American Literary Bureau, Tribune Buildings, New York, to whom subscriptions can be forwarded.

OFFICE: 74 & 75, GREAT QUEEN STREET, LONDON, W.C.

XUM

"KNOWLEDGE,"

An Illustrated Magazine of Science. Plainly Worded—Exactly Described.

EDITED BY RICHARD A. PROCTOR.

EVERY FRIDAY, PRICE TWOPENCE. POST-FREE, 2½D.

PUBLISHED ALSO IN MONTHLY PARTS.

CONTENTS OF PART VII. May, 1882. Price 10d. Post-free 1s.

No. 27.

The Infinities Around Us. By Pasteur—The Future of Knowledge—The Approaching Eclipse—Dr. Siemens on Solar Energy. By the Editor—The Antiquity of Man in Western Europe. By Ed. Clodd. Part II.—The Amateur Electrician: Electric Generators (*Continued*)—Photography for Amateurs. By A. Brothers, F.R.A.S. Part V.—Hanlan and Tricket. By an Old Club Captain—The Naval and Submarine Exhibition—Charles Darwin—M. Pasteur—Development in Foot-Racing—The Comet—The Nebula in Orion—Weather Diagram—Narcotic Indulgences. By M.D.—Seal "Fisheries"—A Dog goes over Niagara Falls Alive—Correspondence: Population of the Earth: A Curious Problem; Cod Sounds and Scientific Privilege, &c.—Answers to Correspondents—Our Mathematical Column—Our Whist Column—Our Chess Column.

No. 28.

Science at the Royal Academy—Old May-day—Crystals. By William Jago, F.C.S., Assoc. Inst. Chem.—The Comet (*Illustrated*)—Population of the Earth. By the Editor—Nights with a Three-Inch Telescope. By "F.R.A.S." (*Illustrated*)—Photography for Amateurs. By A. Brothers, F.R.A.S. Part VI.—The Coming Transit of Venus. By R. A. Proctor (*Illustrated*)—Reviews: "A Ride Across the Channel"—Flowers in May—The Weather Report—Correspondence: Screw-Driver Tubes; Conservation of Solar Energy; Consumption—Answers to Correspondents—Our Mathematical Column: The Laws of Probability—Our Chess Column—Our Whist Column.

No. 29.

Science at the Royal Academy—The Three Cold Days of May. By the Editor.—Crystals. By William Jago, F.C.S.—Assoc. Inst. Chem. (*Illustrated*)—Photography for Amateurs. By A. Brothers, F.R.A.S. Part VII.—Curiosities of Colour. By Henry J. Slack, F.G.S., F.R.M.S.—The "Green-Beam" Paper. (A Sequel.) By Lieut.-Col. W. A. Ross, late R.A.—Measurement of the Focal Length of Deep Convex Lenses. By T. W. Webb (*Illustrated*)—Butterflies and Moths—The Electric Telegraph. By W. Lind—The Comet (*Illustrated*)—The Weather Report—Reviews: "Studies in Microscopical Science"—Land and Water—Correspondence: The "Coney" of Scripture; Probabilities, &c.—Answers to Correspondents—Our Mathematical Column: The Laws of Probability—Our Chess Column—Our Whist Column.

No. 30.

Our New Volume. To Our Readers—Science at the Royal Academy—The Total Eclipse—The Amateur Electrician; Electric Generators (*Continued*)—The Cold Week in May—Photography for Amateurs. By A. Brothers, F.R.A.S. (Part VIII.)—Reviews: Prof. Huxley on Science and Culture—Solar Energy. By Dr. Siemens—Butterflies and Moths—The Stars for June (*Illustrated*)—Weather Charts—Notes on Art and Science—Correspondence: The late Mr. Thos. Dunman; Aurora Borealis; Tobacco and Consumption, &c.—Answers to Correspondents—Our Mathematical Column—Our Whist Column—Our Chess Column.

CONTENTS OF PART VIII. June, 1882. Price 1s. Post-free, 1s. 2d.

No. 31.

Science at the Royal Academy—Was Rameses II. the Pharaoh of the Oppression? By Miss Amelia B. Edwards. I.—The Argument of De Rouge—The Seaside Health Resorts of England. By Alfred Haviland. Introduction—Population of the Earth—Our Ancestors. IV.—The Final Mixture. By Grant Allen—Winning Wagers. By the Editor—Found Links. Part VII. By Dr. Andrew Wilson, F.R.S.E., F.L.S.—Home Cures for Poisons—Amateur Electrician (*Illustrated*)—The Eclipse—Butterflies and Moths. By W. J. H. Clark—Mass and Weight of the Brain—Too Much Brain-Work: Brain Trouble—Weather Chart for the Week ending Monday, May 22—Correspondence—Answers to Correspondents—Our Mathematical Column—Our Chess Column—Our Whist Column.

No. 32.

The Grosvenor Gallery—English Seaside Health Resorts. By Alfred Haviland. Classification—Antiquity of Man in Western Europe. By E. Clodd. Part III.—Crystals. By William Jago, F.C.S., Assoc. Inst. Chem. No. III. (*Illustrated*)—Nights with a Three-Inch Telescope. By "A Fellow of the Royal Astronomical Society" (*Illustrated*) Photography for Amateurs. By A. Brothers F.R.A.S. Part IX.—How to get Strong. Introductory—Weather Charts—Butterflies and Moths. By W. J. H. Clark—Easy Lessons in Blowpipe Chemistry. By Lieut.-Colonel W. A. Ross, late R.A. Lesson VI.—The Baylonian Calendar—Siemens on Solar Energy—Correspondence—Answers to Correspondents—Our Mathematical Column—Our Whist Column—Our Chess Column.

33.

The Grosvenor Gallery—Was Rameses II. the Pharaoh of the Oppression? By Amelia B. Edwards. II.—Joseph's Place in History—The Amateur Electrician: Electric Generators (*Illustrated*)—How to Get Strong—A Study of Minute Life. By Henry J. Slack, F.G.S., F.R.M.S.—Conduct and Duty—English Seaside Health-Resorts. By Alfred Haviland—Home Cures for Poisons—June Flowers—The History of Tubercle—On some Critics—Correspondence—Answers to Correspondents—Our Mathematical Column—Our Whist Column—Our Chess Column.

No. 34.

Ladies Dress Society—Found Links.—Part VIII. By Dr. A. Wilson, F.R.S.E., F.L.S. (*Illustrated*)—Thought-Reading. By the Editor—Crystals. By William Jago, F.C.S. (*Illustrated*)—English Seaside Health Resorts. By Alfred Haviland—The Eyes of Science. By the Editor—Photography for Amateurs. By A. Brothers, F.R.A.S. Part X.—On some Publications of the Christian Knowledge Society—Reviews: "Story of a Museum"—"Curiosities of Vegetation"—Correspondence—Answers to Correspondents—Our Mathematical Column—Our Chess Column—Our Whist Column.

No. 35.

Was Rameses II. the Pharaoh of the Oppression? By Amelia B. Edwards. III.—The Pharaoh of Joseph—Honey Ants. By Grant Allen—How to Ride a Tricycle. By John Browning—Thought-Reading. By the Editor—How to Get Strong—Home Cures for Poisons—The Amateur Electrician: Electric Generators—Electromania. By W. Mattieu Williams—A Surgeon's Tools: Clean or unclean?—Weather Chart for the Week—Star Map for July—Correspondence: Tobacco and Consumption—The Fever Tree, &c.—Answers to Correspondents—Our Mathematical Column—Our Whist Column—Our Chess Column.

Cases for Binding Volume I., price 2s. each. Title-page and Index, price 2d., post-free 2½d.

The Volume consists of the Numbers published from the commencement (Nov. 4, 1881) to No. 30 (May 26, 1882).

Office: WYMAN & SONS, 74-75, Great Queen Street, London, W.C.